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Articles intended for publication should focus on international agricultural education and/or international extension education. Articles should relate to current or emerging issues, cite appropriate literature, and develop implications for international agricultural and extension education. **Manuscripts, or portions of manuscripts, must not have been published or be under consideration for publication by another journal.**

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The editorial board consists of the editors, the past editor and other members representing regions of the world.

Editors

Alexa Lamm, Executive Editor  
University of Georgia  
318 Hoke Smith Building  
Athens, GA 30602  
jiaee@aiaee.org

Todd Brashears, Managing Editor  
Texas Tech University  
Box 42131  
Lubbock, TX 79409-2131  
jiaee@aiaee.org

Kristina Hains, Past Editor  
University of Kentucky  
314 Garrigus Building  
Lexington, KY 40546-0215  
jiaee@aiaee.org

Fallys Masambuka, Assistant Editor  
University of Georgia  
Athens, GA 30602  
jiaee@aiaee.org

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From the Executive Editor

Hello from chilly (but to be fair, it is winter) Lexington, Kentucky! Hopefully you have just finished reading our final 2019 issue in December, but I’m very excited to share with you our 2020 Special Issue. We have begun to publish a special issue once a year (in the future, this will usually occur in January) that focuses on issues the editorial board feels are pertinent and salient to our practitioners, researchers and readers. For this special issue, the focus is on a theory that many consider foundational to our field—Everett Rogers’ Diffusion of Innovations theory.

Specifically, the focus for this special issue was Advances in the Application of Diffusion of Innovations. This theory, which has been used frequently as a theoretical lens for publications within the field (you can see proof of this within the pages of the JIAEE), has served as the backbone of much of the work within agricultural and extension education. As such, we determined it was time to spend some time thinking deeply about a theory that has helped shape our field.

Exclusive to this special issue, are six articles that utilize diffusion in a unique way, to push the boundaries of what we already know about how innovations are diffused. More specifically:

We begin with a Research Note that focuses on how change agents can use networked learning communities (NLCs) to provide support for learning and influence implementation of innovations within a social system.

The next three Research Feature articles challenge us by linking Diffusion of Innovations theory with other equally salient concepts or theories. By connecting Diffusion of Innovations with Service Learning, a model of Emotional Influence, and the Spiral of Silence, we challenge not only how we think about utilizing these models, but also the role that Diffusion of Innovations can play in concert with other theories, in new and emerging fields.

Finally, we end with two research articles that apply this theory within significant on-the-ground international applications. Whether your interest in this special issue is more theoretical in nature, or you are looking for practical applications related to this important theory, there is
something for everyone. Please enjoy these innovative articles, and maybe push your thought processes a little bit regarding Diffusion of Innovations. And finally, as usual, continue doing the great work you do within the field.

Warm Regards,

Kristina D. Hains

Kristina D. Hains
Past Editor, JIAEE
Using A Tiered Approach for Implementing Networked Learning Communities: A Case Study on Developing the Capacity of Leaders to Implement Systemwide Innovations within International Training and Development Programs

James C. Anderson II
University of Georgia

Eric Kaufman
Jama Coartney
Shreya Mitra
Carol Cash
Virginia Tech University

Abstract
This case study demonstrates how change agents can utilize networked learning communities (NLCs) with shared leadership to provide the structural supports for learning and influence the implementation of innovations within a social system. Our focus is the Department of Defense Education Activity (DoDEA), a large school system operating 164 accredited schools domestically and internationally. As part of their systemic priority of implementing innovations for educational improvement, DoDEA worked with extension specialists to create NLCs for instructional leaders using the Engelbart’s Organizational Learning and Improvement Schema. The schema is a three-tiered approach to non-formal learning that facilitates leader capacity building at the individual, team, and systemwide levels. To support these learning communities, DoDEA also created regional support teams or opinion leaders to assist with the implementation of systemwide educational technologies through non-formal professional learning. Focus group discussions provided insights on the impact of this model as a mechanism for diffusing educational innovations throughout the system. Findings suggest that implementation of this approach in other international training and development settings can yield positive impacts on the innovation-decision process.

Keywords: Shared leadership; international training & development; social learning; systemic change; Diffusion of Innovations

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Introduction

Over the decades, the US Federal Government has invested billions of dollars, intellectual resources, and human capital to assist partners globally with addressing challenges related to human development and welfare. This support has reached across many sectors, including agricultural and food security, human rights and governance, health, water and sanitation, and education (USAID, 2018). Unfortunately, leaders who have been charged with facilitating change through these projects often find themselves facing leadership challenges related to capacity, continuity, cohesiveness, and support (Maslin-Ostrowski & Drago-Severson, 2014). In light of the increasing demand for finite resources, federal agencies have sought efficient models for diffusing innovations that yield sustainable improvement. Extension systems have been successful at establishing networks and building strong relationships domestically that provide a space for learning about and adopting new ideas and technologies (Currie & Spyridonidis, 2019; Davis, Dolly, Lamm, & Lamm, 2018). However, this success has yet to be realized through international extension projects. Accordingly, there is an opportunity for extension systems to have an impact on structures that successfully aid in the development of sustainable global learning networks. History supports the claim that the innovation-decision process in international settings can be accelerated by tapping into existing global knowledge and know-how and facilitating the exchange of both external and local knowledge within a country (Fu, Mohnen, & Ventresca, 2015).

Opinion Leaders & Change Agents

Rogers (2003) proposed the Diffusion of Innovations theory to explain how new ideas and technologies are spread. Diffusion is a multi-step process that focus on the conditions that increase or decrease the likelihood that the innovation will be adopted by members of a given system. Rogers (2003) considered diffusion as a type of communication in which members of a social system create and share information with one another through certain channels over time in order to reach a mutual understanding. He suggested five categories of adopters and a 5-step innovation-decision process by which the individuals seek information concerning an innovation. The five steps are:

1. Knowledge: The individual is first exposed to the innovation and acquires knowledge on how it works.
2. Persuasion: The individual forms and opinion regarding the innovation.
3. Decision: The individual decides whether to adopt or reject the innovation.
4. Implementation: The individual applies the innovation to determine its usefulness.
5. Confirmation: The individual seeks affirmation about his/her final decision to innovate.

To aid in the implementation and adoption of the innovation, Rogers (2003) emphasized the role two types of influencers of adoption behavior within the innovation-decision process, the opinion leaders and the change agents. Opinion leaders are members of the social system who exert their influence whereas change agents are influencers who are external to the system. Due to the increasingly complex tasks associated with systemic change, the desire to structure the innovation-decision process around shared member leadership has become more prevalent. However, the question remains, what structural supports do these influencers need in order to help potential adopters implement the new
technologies and/or practices with fidelity and sustainability?

**Conceptual Framework**

Engelbart’s Organizational Learning and Improvement Schema (Bryk, Gomez, Grunow, & LeMahieu, 2015) provides a structure for implementing NLCs to aid in the diffusion of innovations throughout a social system. Originating from his work in systems science, Engelbart sought to find ways to increase human productivity by using the computer as a medium to enhance idea development, collaboration, and organizational communication (Engelbart, 1992). Engelbart articulated this networked community as a model that could enhance human intelligence and the ability to solve complex problems by using technology and an interrelated tiered structure to facilitate social learning and systemwide practice of quality improvement methods.

Finally, **Level-C learning** is when multiple Level-B learning communities connect as a network, using various technologies, to enhance the capabilities of the social system by engaging the members in inter-community learning and improvement work. A key characteristic of this three-tiered approach is the inclusion of a double-loop learning process in which members are able to actively engage in learning by asking questions about changing fundamental aspects of the community (LeMahieu, Grunow, Baker, Nordstrum, & Gomez, 2017), a key component to facilitating organizational improvement through change.

In this case study, the change agents used this three-tiered approach to train the CIL personnel, who then used it to train the local instructional leaders who will train school teachers. While the priorities were vetted internally, DoDEA coordinated with the change agents to facilitate professional learning based on these internal priorities. Previous studies have shown the introduction of external influencers have a positive impact on establishing team empowerment when compared to systemic change implemented by only the established leaders (Rapp et al., 2015). This occurs because change agents come onto the team with the understanding that their role is to empower the team to engage in systemic improvement (see Figure 1). Starting at the individual level, **Level-A learning** is the process in which individuals seek to acquire the knowledge needed to improve their technical competencies. Members reflect on their practices and ways to improve them, focusing on how these practices can contribute to the work of the system. During **Level-B learning**, members participate in a professional learning community to further increase their Level-A performance capabilities through the implementation and internalization of quality improvement methods.

![Figure 1. Schema for Social Learning](image-url)
change; whereas, established system leaders are more closely connected to the system and may not be as willing or able to relinquish power to members (Rapp et al., 2015). The change agents provided professional learning to the CIL personnel through virtual webinars (Level-A) and follow-up regional visits (Level-B). To create a culture of innovation systemwide, all three CILs came together for face-to-face leadership summits and summer symposia to develop a common vision, purpose, language and supports tools for implementation; they also participated in virtual communities of practice (Level-C).

**Purpose & Objectives**

The purpose of this case study is to present a three-tiered approach to networked learning communities (NLCs) with shared leadership that was employed by a team of extension specialists, serving as change agents, to train and support opinion leaders with the US Department of Defense Education Activity (DoDEA) as they developed, trained and influenced the implementation of new educational technologies that improve teaching and learning within their schools globally. These opinion leaders who were organized into regional teams in the Americas, Europe, and the Pacific called Center for Instructional Leadership (CIL) were charged with assisting instructional leaders systemwide with going through the 5-step innovation-decision process.

Networked learning with shared leadership occurs when team members who are innovators or early adopters share responsibilities for influencing the other members in the hopes of maximizing sustained adoption throughout the social system (Bergman, Rentsch, Small, Davenport, & Bergman, 2012). Studies on the impact of these collaborative learning teams with shared leadership have concluded that, when applied properly, the opinion leaders encourage increased productivity, more effective use of resources, better problem solving and decision making, and greater innovation and creativity because they impact both the type of motivation community members have for the innovation as well as the efficiency of communication across time and space (Deci, Olafsen, & Ryan, 2017; Kogler-Hill, 2016; Parker, 1990; Rapp, Gilson, Mathieu, & Ruddy, 2015).

Although confirmed by influencers, the decision to innovate is self-regulated. Self-regulated activities are intrinsically motivating and tap into the psychological need for autonomy or self-determination, competence or professional contribution, and relatedness or belonging (Deci et al., 2017). Adopters benefit from these NLCs with shared leadership because they provide a structure to fulfill these three basic psychological needs, leading to a sense of willingness, volition, persistence, and authenticity among team members (Anderson, 2013).

The CILs were charged with the role of providing non-formal professional learning and support for district instructional leaders who would then replicate this professional learning structure with the local school instructional leaders and teachers. As a large system operating 164 accredited schools in 11 foreign countries and 9 US states and territories (DoDEA, n.d.), DoDEA provides an example of success that can inform Extension services related to building the capacity of international social system leaders to implement systemic change. Objectives guiding this case study were to glean insights on:

1. How well the networked learning communities that were facilitated by Extension specialist as change agents contribute to the development of DoDEA CILs; and
(2) The contribution of CILs as opinion leaders toward influencing sustained adoption of educational innovations by DoDEA’s local instructional leaders.

Methods

The professional learning identified generally focused on building the capacity of local instructional leaders to develop and sustain a culture of innovation, collaboration, continuous improvement, and caring relationships within each school (DoDEA, 2018). Six professional learning sessions supported this initiative, and they were based on:

(1) identifying the components and conditions necessary to support the adoption of educational innovations;
(2) understanding the collaborative cycles of professional learning communities;
(3) facilitating professional learning as an opinion leader;
(4) implementing enhanced professional learning using virtual and blended models of instruction;
(5) understanding approaches to coaching the early majority; and
(6) implementing coaching model to support the early majority.

After the change agents completed professional learning for the opinion leaders, three 60-minute focus group sessions were conducted with CIL personnel related to how well the NLCs contributed to their development as internal influencers. In addition, thirteen 60-minute focus group sessions were held with the local instructional leaders in all three regions to glean insights on the contribution of CILs with influencing them to implement the educational innovations. The sessions were recorded, transcribed, loaded into Dedoose web applications for qualitative research, and analyzed using constant comparison analysis (Onwuegbuzie, Dickinson, Leech, & Zoran, 2009).

Findings

The following sections provide a high-level summary of the key takeaways from the discussions by the CILs related to using NLCs and the local leaders related to the impact of the opinion leaders with influencing adoption of the educational innovations taught in the six sessions.

CIL Personal Reflection on the Use of NLCs

When asked about the impact of the professional learning using this networked approach, one CIL member stated, “When we learn together, we grow together. You know; and we’re learning, and we’re working, and we’re growing stronger…We just need to be able to replicate these opportunities, whether virtual or face-to-face.” Another mentioned:

We talked about whole-group, small-group, and individualized, and we’re modeling that for them as well. So, I think those are some things that are very important. We’re trying to model and practice what we preach, so to speak.

Using the Engelbart’s Organizational Learning Schema, an organization can articulate and promote its vision through appropriate professional learning at all levels. One CIL team member discussed an example of how they are implementing what they have learned: “The [DoDEA] Blueprint [for educational innovation] is our driver now, and our summit is around [understanding and implementing] the Blueprint.” Another CIL member reflected on how they are contributing to creating a culture of collaboration using high-powered teams:
We are extremely focused and aligned to organizational priorities and continuing with them throughout the year… Our priorities are aligned to the DoDEA-wide priorities, and then we develop our plan off of that… We just don’t veer from the system priorities.

Overall, the opinion leaders did not express concerns with using NLCs, but did express a desire to be an integral part of the identification of the content to be covered in the NLCs, which was decided by the organizational leaders in consultation with the change agents. In addition, the virtual learning experience and use of technology varied for some locations due to issues with infrastructure.

Instructional Leaders’ Reflections on the Impact of the CILs as Influencers

When the CILs were created, one of the primary purposes of these internal influencers was to provide systemic leadership development and support based on DoDEA policies, procedures, and programs for teacher leadership, school-level administrators, district specialists, and superintendents (DoDEA, 2016). Accordingly, district- and school-level instructional leaders expressed appreciation for how the CILs have been meeting their individual needs and empowering them to create desired changes, but stated this appreciation took a while to realize as the structure was new and not well articulated to the members. One participant stated: “They are our messengers to help the districts tie in our vision, our priorities, our Blueprint, our AdvancEd [assessment program]. All of those things…have to go together.”

Instructional leaders highlighted specific CIL services, which included personal visits to their schools and timely professional learning opportunities. The instructional leaders discussed how the CILs’ work extends beyond offering standardized professional learning, it encompasses tailored support. For example, another participant shared:

Well I think more important, is the professional development that DoDEA has provided for the administrators too, because I think for a long time that wasn't there. And implementing the CIL in order to have that kind of training for us available was crucial and—I think—critical to making this move forward for us and helping us along with it. [Without it,] I don’t think we'd be as far along as we were/are.

As it relates to creating a culture of innovation, implementation and confirmation, one instructional leader stated: The walkthrough tool…is their biggest contribution to school so far…We can meet from different schools [and] use a common vocabulary; we've all had the same training. We're all utilizing it; we're putting our stuff on the SharePoint page…We can network with a common vocabulary and a common vision and purpose, just as a first-level step—utilizing the walkthrough tool. I don't know what's coming next; but if they build on that, then we've already got kind of [an] expectation and a culture in place that we can communicate across.

While instructional leaders indicated they were already overwhelmed with responsibilities and the adoption of new practices were adding to that stress, they recognized the need to implement innovations that may be uncomfortable, and they appreciate the CILs’ role in supporting
them through the change process. A stakeholder explained it this way:

One of the biggest obstacles is always how warm and cozy the status quo is. I mean, that's a tough place to leave. And the CIL can certainly help us point out the advantages to making that leap, in terms of our mission. Because, you know, that warm and cozy status quo: It's really hard to get some folks motivated to seek alternative ways.

Conclusions & Recommendations

Although the case was focused on the diffusion of educational innovations within an organization with members worldwide, it is relevant to various agriculture and extension situations when looking at how external influencers can work with internal influencers to implement training and development that encourages sustained adoption of an innovation throughout the social system. Both CIL personnel as opinion leaders and local instructional leaders as team members at various stages of knowledge, persuasion, and adoption agreed that using NLCs provided opportunities for individual and team development that influenced the implementation and confirmation of the innovations being taught.

A major benefit to this approach includes having consistent learning outcomes or messages about the innovation while being able to create training and support strategies that are tailored to meet the needs of the individual member by leveraging the power of social and self-regulated learning. Conversely, the biggest concerns with implementation was first understanding the purpose of the opinion leaders in the innovation-decision process, issues with infrastructure/resource related to implementing the innovation, and the lack of input by the opinion leaders when the professional learning was being developed. Clarity of purpose, proper infrastructure for implementing the innovation, and inclusion of internal influencers from the beginning are key to positive persuasion and confirmation.

To this end, what do the outcomes for this case mean for project leaders who are interested in implementing systemic change within an international context? While the diffusion of innovations is not new to education or international development initiatives, implementing protocols with fidelity that can be sustained once the change agent leaves remains difficult (Anderson, Alegbeleye, Gichane, & Abaye, 2019; Park et al., 2013). The tiered approach to professional learning with shared leadership for developing and supporting members through the innovation-decision process presented in this case study is based on current literature in change management and professional learning, and the example, although not generalizable, provides extension specialists with a framework to follow when planning and facilitating systemic change that is based on the need to adopt an innovation within a community or organization. The creation of NLCs with shared leadership encourages a sense of autonomy, competence, and relatedness (Deci et al., 2017; Rapp et al., 2015), which translates into the establishment of shared goals, empowerment of members to be an active part of the process, adoption of a common vocabulary, and the implementation of new policies, procedures, and tools with fidelity and sustainability. However, some suggestions for moving forward are: 1) change agents must clearly articulate their role and the role of the opinion leaders; 2) take into account the infrastructure and resources of the social system when designing learning activities and considering what innovations to offer; and 3) ensure that
the internal influencers are brought to the table during the program development stage.

References


Overcoming Resistance to Service-Learning’s Use in the Preparation of Teachers for Secondary Agricultural Education: A Reframing of the Method’s Diffusion Challenges

Richie Roberts
Louisiana State University

M. Craig Edwards
Oklahoma State University

Abstract
Although service-learning (SL) has shown promise, its adoption as a method of instruction in secondary agricultural education remains tentative. As such, this philosophical investigation examined how resistance to SL might be uniquely manifested in the context of teacher preparation and the implications for agricultural education if viewed through the lens of Rogers’ (2003) diffusion of innovations theory. After synthesizing related research and theory, we argue the method of instruction’s barriers to adoption include not only a misalignment between teacher educators’ beliefs and practices, but also result from a lack of knowledge, including (a) awareness, (b) how-to, and (c) principles (Rogers, 2003). We also posit that contextual influences at three levels – personal, institutional, and societal – drive or constrain teacher educators’ knowledge of SL during the innovation-decision process. By reframing the problem in this way, implications emerge regarding the difficulties teacher educators may experience as they cross contextual borders and attempt to overcome the knowledge deficiencies likely to influence their pedagogical decision-making. In this regard, we offer an expansion to Rogers’ (2003) innovation-decision process so teacher educators can forecast, isolate, and address better the contextual challenges and knowledge-related problems likely foregrounding their resistance to adopting SL as a method of instruction.

Keywords: Diffusion of Innovations theory; innovation-decision process; resistance; service-learning; teacher preparation
Introduction

During the 1960s and 1970s, university campuses experienced one of the most tenuous and turbulent periods in U.S. history (Fraser, 2014; Urban & Wagoner, 2014). From the War on Poverty to protests about civil rights and the Vietnam War, campuses often became ground zero for illuminating the nation’s social, cultural, and economic inequities and shortcomings (Speck & Hoppe, 2004). During this tumultuous period, student activists and humanistic-oriented faculty questioned many of the academy’s failing structures (Bloom, 1978; Stanton, Giles, & Cruz, 1999). For example, as institutions of higher education across the nation diversified regarding sex, race, and social-economic status, these actors devoted effort to community-based movements intended to address societal inequalities (Crews, 2002). This chipping away at public problems caught the attention of individuals who saw value in curricular aims also calibrated to address the needs of communities (Speck & Hoppe, 2004). Even though early pioneers of this movement often worked against the grain and independent of one another, by the end of the 1960s, they began to discover one another’s work, conceptualize the movement’s pedagogical worth, and establish service-learning (SL) as a method of instruction (Zieren & Stoddard, 2004).

Although scholars struggled to define SL during its formative years, Bringle and Hatcher (1995) suggested it was an instructional method that engaged students in service-based experiences that enhanced their understanding of course concepts while also allowing them to make meaningful contributions in their local communities. After the method’s emergence at the close of the 1960s, its use soared in U.S. universities, especially during the past two decades (Hou & Wilder, 2015). Due to its diffusion in higher education, researchers have had opportunities to demonstrate that SL can be used to improve students’ academic learning, civic responsibility, personal development, and attitudes toward working with individuals from diverse backgrounds and viewpoints (Conway, Amal, & Gerwein, 2009; Warren, 2012; Yorio & Ye, 2012). Such findings as well as increasing demands on universities to provide students with experiences to apply their learning in real-world settings appear to have further catalyzed SL’s adoption as an instructional method (Bulot & Johnson, 2006; Butin, 2006; Heckert, 2009). However, disagreements about the role of the university and faculty regarding public service continue to intersect with the use of SL as a method to facilitate student learning (Hou & Wilder, 2015; Stanton et al., 1999). As a consequence, university faculty, including teacher educators, have often found themselves in precarious waters through which they must steer the primary aims of higher education – while navigating the crosscurrents of competing discourses, motivations, and policies (Butin, 2006, 2010).

For example, a cardinal assumption in the academy is that faculty have the knowledge and skills to provide quality instruction to students in their respective content areas (Gelman, Holland, Driscoll, Spring, & Kerrigan, 2001). However, evidence (Bringle & Hatcher, 1996; Matofari & Edwards, 2017) demonstrates that university faculty often receive little formal training about teaching and learning, especially for instructional methods such as SL (Gelman et al., 2001). Even though some higher education institutions do provide training and support to improve faculty members’ instructional acumen, these efforts tend to emphasize emerging trends in collaboration, course design, and syllabi development (Cranton, 2011; Schumann, Peters, & Olsen, 2013) rather than specific
teaching methods. In response, some scholars (Bringle & Hatcher, 1996; Gelmon et al., 2001; Henderson, Fair, Sather, & Dewey, 2008) have called for placing more focus on professional development opportunities that feature SL as a method instruction. Through such initiatives, faculty can learn how to provide students with real-world, service-based learning experiences in more integrative and complementary ways while supporting their universities’ missions, which often include the elements of teaching, research, and service (Henderson et al., 2008).

To understand better the adopters of SL in higher education, McKay and Rozee (2004) examined attributes of faculty who used the method through the interpretive lens of Rogers’ (2003) diffusion of innovations theory. Findings demonstrated that adopters saw SL as exhibiting relative advantage (Rogers, 2003) over other teaching methods because it could be used to enhance students’ learning while also inducing positive change in local communities (McKay & Rozee, 2004). Adopters of the method also articulated that SL was compatible (Rogers, 2003) with their underlying philosophies about teaching and learning (McKay & Rozee, 2004).

In a similar investigation, Pribbenow (2005) reported that after a trialability phase (Rogers, 2003) with the method, SL adopters perceived that their students’ learning of course concepts was enhanced. The adopters also expressed forming more meaningful relationships with students and having had greater impact on society (Pribbenow, 2005). Cooper (2014) further distilled the defining characteristics of early faculty adopters of SL through a series of in-depth interviews. His findings indicated instructors adopted SL because they (a) had an interest in community engagement, (b) perceived SL produced positive student outcomes, (c) received encouragement from other faculty members, and (d) wanted to give back to society (Cooper, 2014).

However, after embracing SL, faculty often encounter a number of complicated challenges (Conville & Kennell, 2002). For instance, faculty, students, and community members frequently hold different perspectives on the purposes of a SL experience as well as may have limited time and resources to support proper implementation of the teaching method (Abes, Jackson, & Jones, 2002; Hou & Wilder, 2015). Such obstacles have caused some instructors to abandon the method (Conville & Kennell, 2002); a behavior that Rogers (2003) described as disenchantment rejection regarding a previously adopted innovation.

SL, therefore, faces a critical juncture in higher education particularly regarding the preparation of future teachers, including instructors of agriculture for secondary schools (Roberts & Edwards, 2015, 2018). To this point, even though mounting evidence has demonstrated the important role SL could play in teacher preparation, Roberts, Edwards, and Robinson (2019b) reported that its use by teacher educators of agricultural education was largely nonexistent. Given this, more work is needed to understand why teacher educators (a) resist using SL as a way to enhance the learning of preservice teachers, and (b) fail to feature how the method could be used to teach secondary agricultural education.

Purpose

This philosophical study examined the preparation of teachers for U.S. school-based, agricultural education regarding why the discipline has largely resisted the adoption of SL as a method of instruction by examining this phenomenon through the lens of diffusion of innovations theory (Rogers, 2003). To achieve this purpose, we
(a) synthesized existing research and theory on resistance to change; (b) reframed resistance to SL as a multifaceted knowledge problem; and (c) offered an expansion to Rogers’ (2003) innovation-decision process to assist teacher educators of agricultural education in overcoming knowledge deficits and contextually anchored obstacles that may impede their adoption of SL and efforts to diffuse the method to preservice students. It is important to note that the aim of philosophical research is not to offer empirical truths, but rather stir debate and dialogue that pushes our thinking forward (Reichling, 1996). In particular, high quality philosophical investigations seek to explore various perspectives, evidence, and theories through a process of analysis, synthesis, and interpretive introspection to present new insights about emergent findings (Reichling, 1996). To accomplish this, we examined existing research and theory on SL and resistance to change in concert with Rogers’ (2003) diffusion of innovations theory. Then, we synthesized our findings as a narrative and incorporated core features of that into Rogers’ (2003) innovation-decision process, especially regarding the primal and catalytic role played by knowledge acquisition and its impact on the behaviors of potential adopters.

**Synthesis: Research and the Theory of Resistance to Change**

In recent decades, the construct of resistance has been examined across a plethora of academic disciplines and perspectives regarding change. Although resistance can be interpreted as unfavorable, Solorzano and Delgado Bernal (2001) suggested that it is essential to the wellbeing of social systems because innovations can introduce unintended consequences with negative outcomes for society. Though having been well-studied, the literature remains largely divided about which forces should be attributed to what most profoundly manifests resistance to innovative educational practices. For example, Talke and Heidenreich (2014) asserted that resistance is largely fomented at the individual level through judgments made by potential adopters about an innovation’s attributes such as its relative advantage, complexity, and cultural appropriateness. However, Burnes and Jackson (2011) as well as Dent and Goldberg (1999) maintained that an innovation’s likelihood of achieving a critical mass of adopters in education is more closely associated with its acceptance within institutional or discipline-specific contexts. As such, a deficit of understanding endures about the factors likely to foreground potential adopters’ resistance to new educational methods, including SL.

Despite this incongruity of studied opinion, both positions offer critical insights that if considered in tandem depict the complexity of resistance to SL as an often-used instructional approach. As an illustration, the general public might view teacher educators’ roles in education as merely imparting practical knowledge to preservice teachers while also educating them about a range of pedagogical approaches to use in their future classrooms. However, the storied history of education demonstrates that teacher preparation is not so straightforward as may be thought (Fraser, 2014). Instead, teacher educators must navigate complex policies and initiatives coupled with limited time. As a result, these educators often prioritize advancing the methods viewed as most useful to preservice teachers in their future practice while resisting others perceived as less efficacious or important (Anderson & Pickeral, 1998). Therefore, whether teacher educators adopt or resist an innovation, such as SL, is grounded in a complex confluence...
of their educational backgrounds, epistemological beliefs, personal experiences and knowledge, among other key factors (Chambers & Lavery, 2012; Hart & King, 2007). Given this, it was useful to examine the multiple dimensions of resistance expressed by teacher educators toward SL.

To begin, we must understand that for most potential adopters SL represents a departure, or change, from traditional classroom teaching (Roberts & Edwards, 2018). The implementation of SL would require many instructors to transition from a predominantly behavioristic approach in which they, as authority figures, passively impart knowledge to students to instead use a method that allows the sharing of power and the co-construction of learning by all participants, i.e., a constructivistic orientation to teaching and learning prevails (Doolittle & Camp, 1999; Zieren & Stoddard, 2004). For many educators, such a change would initiate dissonance, which is a cognitive process by which individuals begin to question their existing beliefs, values, and worldviews (Speck & Hoppe, 2004).

Dissonance can be an uncomfortable state of mind that contradicts an individual’s natural inclination to maintain consistent beliefs and behaviors (Burnes & Jackson, 2011; Peters, 2012). Therefore, when individuals are exposed to incongruities regarding their beliefs, they may attempt to regain stability through resistance (Lewin, 1946, 1947; see Figure 1). For example, while learning about SL educators may perceive it gives too much autonomy to students; therefore, they dismiss it due to a fear of losing control. To this point, if individuals perceive a change violates existing expectations, norms, or established procedures in a given context, they often view it as an unreasonable and unacceptable choice to make (Dent & Goldberg, 1999). Further, if a proposed change too intensely disputes a person’s worldview, the likelihood of he or she resisting by more assertive measures increases significantly (Cummings & Worley, 2009).

Figure 1. Application of resistance to change (Lewin, 1943) as contextualized to the adoption of service-learning (SL) by teacher educators of agricultural education.

The literature, therefore, has primarily focused on the role that personal factors, such as perceptions of dissonance, have played in shaping resistance to embracing an innovation. However, when Lewin (1943) first introduced the concept of resistance to change, he placed greater focus on the context in which the resistance was manifested. In particular, Lewin (1943) argued that behaviors, whether individual or
group, are the result of a combination of forces that drive or restrain an action, such as teacher educators deciding to adopt SL or rejecting such a change to their practice (see Figure 1). For example, if the combination of forces in a given context were generally supportive of SL, then the method of instruction would be more readily adopted while the opposite is likely if perceived forces were mostly contrarian. The restraining forces that have been consistently identified to influence the adoption of SL by faculty in higher education include accountability, curriculum requirements, institutional culture, teaching evaluations, tenure policies, testing procedures, and unclear standards (Abes et al., 2002; Antonio, Astin, & Cress, 2000; Banerjee & Hausafus, 2007; Burch, 2013; Colbeck & Wharton-Michael, 2006; Conville & Kennell, 2002; Cooper, 2014; Demb & Wade, 2012; Hou & Wilder, 2015; Jaeger & Thornton, 2006; Kezar, 2013; Russell-Stamp, 2015; Ward, 2003).

Through a synthesis of research findings and theoretical perspectives, we demonstrated the importance that personal and contextual factors play in influencing individuals’ resistance to change within the social milieus in which they operate and perform their professional roles. Such was necessary to illustrate resistance to change as a multidimensional construct. This also illuminated the need to reconceptualize the resistance of teacher educators to adopting SL as a method of instruction. We next address how resistance to SL could be reframed to better facilitate its adoption in the preparation of secondary agricultural education teachers for the United States and perhaps that of teacher education practitioners elsewhere in the world.

**Reframing Resistance to SL**

To reframe resistance to SL, we must acknowledge its connection to change. For example, before using SL teacher educators would likely undergo a process by which they decided to adopt or reject the method, i.e., a conceptual model that Rogers (2003) posited as the innovation-decision process (see Figure 2). This process is initiated by an individual’s desire to seek and process information regarding whether the adoption of an innovation may be beneficial, irrelevant, or potentially harmful. Rogers (2003) theorized that the innovation-decision process unfolds through five stages: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation (see Figure 2).

In the first stage, knowledge, individuals gain an understanding of the innovation’s existence and seek to understand its purpose (Rogers, 2003). To this point, Rogers (2003) suggested that three types of knowledge exist and may be acquired about an innovation: (1) awareness-knowledge, (2) how-to knowledge, and (3) principles-knowledge (p. 173). Awareness-knowledge reflects a basic understanding of an innovation that an individual may form by asking questions such as “What is the innovation?” “How does it work?” and “Why does it work” (Rogers, 2003, p. 172). As individuals move beyond basic introductory awareness, they often seek information that will help them understand ways to appropriately use the innovation, or how-to knowledge (Rogers, 2003). The third type of knowledge identified by Rogers (2003), principles-knowledge, refers to when individuals seek to understand how an innovation functions by comprehending its underlying principles of operation which may imply having sufficient grasp of related technical, scientific, and mathematical concepts.

The second stage of the innovation-decision process, persuasion, represents the perceptions of individuals about innovations, either positive or negative attitudes or dispositions, which largely influence their adoption decisions (Rogers, 2003). It is important to note that before this stage, some individuals have already questioned their need to adopt the innovation under consideration. However, it is when individuals enter the decision stage that they may decide to either, actively or passively, resist or reject an innovation (Rogers, 2003). If choosing to adopt, they transition to the implementation stage during which the innovation’s use is incorporated into their regular practice. In the final stage of the innovation-decision process, confirmation, individuals seek to validate...
their adoption decisions (Rogers, 2003). It is during this stage that they decide to continue to use an innovation, discontinue its use, adopt after having rejected earlier, or sustain their initial stance regarding rejection (see Figure 2).

Agricultural education’s literature has provided only limited insight about the factors that influence whether, to what degree, how, and why teacher educators adopt SL. For instance, a recent study reported that the use of SL by teacher educators was largely nonexistent, i.e., they had resisted adopting the method of instruction in their teaching practice (Roberts et al., 2019b). Further, Roberts, Edwards, and Robinson (2019c) indicated that statistically significant and inverse relationships ($p < .05$) were found between teacher educators’ beliefs about the benefits SL could provide to classrooms and communities and their intentions to use the method in teacher preparation courses. Teacher educators’ beliefs about the barriers to using SL at the classroom level in agricultural education also demonstrated a statistically significant and positive relationship ($p < .05$) with their intentions to not use the method in teacher preparation (Roberts et al., 2019c). Although these investigations indicated the method could be beneficial, the teacher educators studied did not intend to use it due to perceiving barriers to implementation. The educators’ views about obstacles reflected having insufficient how-to and principles-knowledge (Rogers, 2003), and, therefore, held sway in their decision-making processes (Roberts et al., 2019b, 2019c).

To further understand these teacher educators’ resistance to SL, Roberts, Edwards, and Ivey (2019a) analyzed their study’s quantitative variables yielding statistically significant relationships by using cluster analysis and qualitative research procedures. This analysis produced three unique clusters operationalized as typologies that represented the planned behaviors (Ajzen, 1991) of teacher educators in regard to using SL as a method of instruction: (a) Optimistically Unaware, (b) Policy-focused Decision Makers, and (c) SL Implementers (Roberts et al., 2019a). The Optimistically Unaware expressed positive beliefs about SL but did not understand how to integrate it in their teaching methods courses (Roberts et al., 2019a). The second cluster, Policy-focused Decision Makers, included individuals with SL intentions that varied considerably. In-depth analysis revealed that these teacher educators used established education policy standards as anchors when navigating the decision-junctures in their course design processes. Whereas, members of the third cluster, SL Implementers, espoused strong beliefs about the method’s potential and emphasized how it could be used to enrich teacher preparation. By viewing Roberts et al. (2019a) findings through the lens of Rogers’ (2003) diffusion of innovations theory it became apparent that teacher educators’ innovation-decisions regarding SL are nuanced and varied.

As such, this literature on teacher educators’ use of SL in the preparation of future instructors of agricultural education (Roberts et al., 2019a, 2019b, 2019c) explicates how variant forces intertwine and work together to influence their resistance to the instructional innovation. Such complexities in the literature reveal the need to reframe teacher educators’ understanding of the method and confounding variables surrounding its adoption. Therefore, we argue that SL’s barriers to adoption involve a misalignment between teacher educators’ beliefs and practices emanating from a dearth of knowledge, including Rogers’ (2003) three types of knowledge: (a) awareness, (b) how-to, and (c) principles. We also posit that contextual influences at
three levels – personal, institutional, and societal – either drive or restrain (Lewin, 1943; see Figure 1) teacher educators’ knowledge- and information-seeking behaviors about SL during their innovation-decision processes (Rogers, 2003). By reframing the phenomenon in this way, implications emerge to understand better the difficulties teacher educators may experience as they cross contextual borders as well as the knowledge deficiencies to likely influence their pedagogical decisions, especially regarding the adoption of SL. To address this need, we offer the Reframing Resistance to Service-Learning Model (see Figure 3). Thereby, teacher educators can forecast, isolate, and address better the contextual challenges and knowledge-related deficiencies likely foregrounding their resistance to adopting SL as a method of instruction for the preparation of secondary agricultural education teachers.

<table>
<thead>
<tr>
<th>Driving Forces</th>
<th>Awareness-Knowledge</th>
<th>How-to Knowledge</th>
<th>Principles-Knowledge</th>
<th>Restraining Forces</th>
</tr>
</thead>
</table>
| Personal       | • Accessing curriculum and other learning resources  
                 • Time  
                 • Opportunities to partner locally | • Applying SL models and examples  
                 • Motivating students through SL experiences  
                 • Self-efficacy to use SL | • Understanding theoretical perspectives undergirding SL  
                 • Understanding power relations among teachers, students, and community partners | Personal |
| Institutional  | • Availability of resources  
                 • Tenure and promotion considerations  
                 • Lack of professional development opportunities | • Evaluating students’ SL work  
                 • Integrating SL into university-mandated course syllabi formats and designs |  | Institutional |
| Societal       | • Balancing perceptions of value – behavioristic vs. constructivistic views on learning and education as a public good  
                 • Perceived value of cooperative learning strategies | • Aligning SL experiences with state and national teacher preparation standards  
                 • Maintaining rigor and relevance | • Negotiating beliefs about ways to prepare secondary agricultural education teachers  
                 • Navigating issues of race, class, gender, and other antecedent variables | Societal |

*Figure 3. Reframing Resistance to Service-Learning (SL) Model. The model integrates Rogers’ (2003) knowledge types and Lewin’s (1943) conceptualization of resistance in a contextualized matrix regarding the use of SL in the preparation of secondary agricultural education teachers.*

As depicted in the model, we suggest that personal forces contribute to teacher educators’ knowledge deficits regarding SL’s use. For example, researchers (Roberts et al., 2019a) have demonstrated that some teacher educators resist adopting SL because they lack a general understanding, i.e., awareness-knowledge, of the method, and may question its effectiveness. They also perceive lacking access to high quality curricular resources and information about potential community partners and to not
having the time needed to properly facilitate SL experiences for students (Roberts et al., 2019c). This absence of sufficient awareness-knowledge ultimately influences teacher educators’ how-to knowledge (Rogers, 2003). In particular, teacher educators may be unaware of how to appropriately conceptualize and then operationalize the method, which diminishes their self-efficacy to implement it and thereby motivate students to take SL actions in the community (Roberts et al., 2019c). We also advance the notion that teacher educators’ resistance to SL may be further entrenched by a lack of principles-knowledge because they lack proper understanding of the theoretical perspectives needed to navigate potential issues of power to likely emerge among key actors, including their students, community partners, and themselves (Roberts & Edwards, 2018).

Although personal forces may greatly affect teacher educators’ resistance to SL, our reframing of this phenomenon also clarifies how institutional forces can influence their knowledge-based views regarding this instructional approach. As an example, tenure and promotion (T&P) expectations in higher education have been shown to influence how faculty allocate their time in regard to teaching, research, and service (Bringle & Hatcher, 1996; Gelmon et al., 2001; Henderson et al., 2008). Therefore, faculty may be dissuaded from seeking awareness-knowledge (Rogers, 2003) due to a paucity of resources and professional development opportunities perceived necessary to understand how SL could complement their fulfillment of T&P requirements. Further, teacher educators may also struggle with aspects of how-to knowledge (Rogers, 2003) concerning strategies to use in upholding institutional expectations for rigor when evaluating students’ work. In this regard, they may struggle with describing a SL project’s requirements in course syllabi and, therefore, forego including such as a learning expectation (Roberts et al., 2019a). As demand for academic rigor rises coupled with increasing state and national teacher credentialing standards, some teacher educators may be challenged due to lack of sufficient principles-knowledge (Rogers, 2003), especially regarding their institutions’ expectations (Roberts et al., 2019a).

We also contend that societal forces shape teacher educators’ knowledge and beliefs about SL (Roberts et al., 2016; Roberts & Edwards, 2018). To illustrate, consider the plethora of training methods, models, and priorities in the preparation of secondary agricultural education teachers (Phipps, Osborne, Dyer, & Ball, 2008; Torres, Kitchel, & Ball, 2010). Depending on training and background, some teacher educators may place more value on behavioral outcomes, i.e., vocational skills development, rather than modeling SL as a method of instruction poised to imbue students with democratic principles and community-oriented actions supporting social justice (Roberts & Edwards, 2018). They may dismiss approaches not aligned with their instructional orientations and, therefore, fail to seek out awareness-knowledge (Rogers, 2003).

Societal forces and norms also complicate teacher educators’ resistance to SL in other ways (Roberts & Edwards, 2018). For example, in their attempts to uphold state and national teacher accreditation policies, these educators may lack how-to knowledge (Rogers, 2003) about meeting such requirements while also engaging their students in meaningful SL projects (Roberts et al., 2019a). Moreover, some may require additional principles-knowledge (Rogers, 2003) to adroitly interpret and implement SL as an
An Expansion of Rogers’ Innovation-Decision Process

This philosophical treatise examined the complexity of teacher educators’ resistance to adopting SL as a method of instruction for preparing teachers of agricultural education. To wit, we clarified why teacher educators may perceive that SL is beneficial at the classroom and community levels (Roberts et al., 2019b) but they struggle with executing the method due in part to the restraints imposed by multilevel contextual forces (see Figure 3). This reframing provides new insights into understanding whether adoption of the instructional innovation will accelerate and reach a critical mass (Rogers, 2003) among teacher educators, and also illuminates the need to broaden our scope and appreciation of the larger phenomenon.

In Figure 4, we offer our expansion to Rogers’ (2003) innovation-decision process. In particular, the expansion more prominently depicts the influence of communication, including sources and actors, on potential adopters acquiring the three types of knowledge described by Rogers (2003). The expansion also integrates Lewin’s (1947) conceptualization of resistance to change by illustrating how driving and restraining forces at the personal, institutional, and societal levels may influence the knowledge of teacher educators regarding their adoption decisions about SL. We argue that this expansion can provide opportunities to overcome existing contextual restraints and knowledge deficits that foster and reinforce resistance to SL among teacher educators. We also posit that it may catalyze further research, additional theory-building, and more effective practices to likely augment the use of SL in the preparation of secondary agricultural education teachers and similar professionals.
Figure 4. A proposed expansion of Rogers’ (2003) Innovation-Decision Process, as contextualized to the adoption of SL as an instructional method by teacher educators of agricultural education.

Discussion, Implications, & Recommendations

Change continues to pervade, reform, and transform education; for example, increased emphasis has been placed on rigor, accountability, and aligning curriculum with state and national standards (Kirsch, Braun, Yamamoto, & Sum, 2007). As one consequence, many educators, at all levels of schooling, perceive their autonomy in regard to teaching and guiding the learning of students is increasingly constrained if not unduly limited (Cox, 2004; Cranton, 2011; Schumann et al., 2013). Such pressures also influence educators’ decisions regarding choices of instructional methods to use in their classrooms, including whether to employ SL (Ball & Geleta, 2012; Lake & Jones, 2008).

However, by rejecting SL, or other instructional methods, teacher educators may negate their potential to facilitate critical outcomes for teacher candidates such as improved empathy, ethics, and problem-solving abilities (Ball & Geleta, 2012; Barnes, 2016; Carrington & Saggers, 2008; Chambers & Lavery, 2012; Daniels, Patterson, & Dunston, 2010; Hildenbrand & Schultz, 2015; Meaney, Griffin, & Bohler, 2009).

Recent literature in agricultural education (Roberts et al., 2019a, 2019b, 2019c) primarily depicts this problem as a chasm between teacher educators’ beliefs and practices. However, we offer a counter-narrative to such a notion, i.e., to only view the problem in this way is too narrow. Instead, the resistance to SL should be
conceptualized as a multifaceted learning problem. To that end, we provided an amplified view into the complex intersection of how knowledge or the lack of, context, beliefs, and uncertainties may conflate to uniquely presage a teacher educator’s resistance to SL as a method of instruction (see Figure 3). It is also critical to recognize that teacher educators frequently experience little support regarding the implementation of SL as a method of instruction for preservice teachers of agricultural education. Of note, lack of support is one of the primary reasons why innovations fail to reach a critical mass of adopters in higher education (Byrck, Gomez, Grunow, & LeMahieu, 2015). To move forward, therefore, it is essential that teacher educators be afforded the tools necessary to navigate these multilevel forces (see Figure 3) while also acquiring the knowledge (Rogers, 2003) needed to overcome resistance to using SL in the preparation of agricultural education teachers. Although our expansion of Rogers’ (2003) innovation-decision process (see Figure 4) is meaningful, investigatory efforts are needed to empirically test its value. As such, we recommend that research be undertaken to validate the expansion as proposed. Future theory-building efforts should examine how personal, institutional, and societal forces may also affect the way in which individuals perceive the attributes of SL as an innovation worthy of adoption. This information may be vital to addressing issues related to communication with and the professional development of teacher educators. Future quantitative studies should investigate how Rogers’ (2003) types of knowledge and Lewin’s (1947) conceptualization of resistance may uniquely influence the attitudes of potential adopters. Such an interaction could be explored by using structural equation modeling to examine the direct and indirect effects of variables on the attitude formation of teacher educators.

After issues related to teacher educators’ knowledge of SL are addressed, additional work will be needed to guide them through the remaining elements of Rogers’ (2003) innovation-decision process, i.e., the persuasion, decision, implementation, and confirmation stages. To help facilitate this process, it is critical to identify opinion leaders (Rogers, 2003) who most profoundly influence the use of instructional methods and other learning techniques to prepare teachers of agricultural education. We further recommend that social network analysis be used to more precisely define and measure teacher educators’ communication channels and to identify actors connected at the node, dyad, and network levels (Borgatti, Everett, & Johnson, 2018).

Rogers (2003) noted that opinion leaders are essential to the diffusion process, so obtaining a better understanding of these individuals regarding teacher educators’ social networks is critical. After such individuals are identified, qualitative research methods could help distill the beliefs and values communicated by these opinion leaders that allow them to exhibit influence over their followers regarding instructional practices and adoption of innovations such as SL. If analyzing the later stages of the innovation-decision process for SL, we also recommend that investigations extend beyond self-reported measures to also examine latent perceptions and reactions of teacher educators during their decision-making processes, e.g., by applying biometric analyses (Dunstone & Yager, 2008).

In development of the Reframing Resistance to Service-Learning Model (see Figure 3), we intended to create a matrix that could be used to detect potential challenges that teacher educators may
experience regarding the adoption of SL. Perhaps professional development could be created for teacher educators of agricultural education and this model serve as the guiding framework to organize such programming. We caution, however, that additional work is needed to validate the model’s utility. We also recommend that researchers and practitioners explore whether this framework could be modified to help mitigate knowledge-related diffusion issues for other educational innovations. Before engaging in such efforts, we further suggest that researchers explore the driving and restraining forces (Lewin, 1947) specific to such innovations and the related contexts to ensure they appropriately apply the model or a variation of it. By conceptualizing their diffusion challenges in this way, agents of change could better identity gaps or deficiencies and modify related efforts as needed.

By reframing teacher educators’ adoption behaviors regarding SL as a method of instruction, we demonstrated how such a reconceptualization could broaden opportunities for research, theory-building, and practice. Moving forward, we recommend that when diffusing educational innovations in higher education, more attention should be focused on the role of knowledge, including its various types, as well as the contextual forces likely to impact rate of adoption, continuance, discontinuance, or rejection (Rogers, 2003). By exploring how these forces amplify, coalesce, or even clash within social systems, we posit that other fortuitous possibilities as well as ambiguous limits will be revealed.

References


Community Reaction towards Social Innovation: A Discussion of Rogers’ Diffusion of Innovations Theory in Consideration of Community Emotional Response

Bryan J. Hains
Kristina D. Hains
University of Kentucky

Abstract
While originally utilized within the natural and agricultural sciences, the diffusion of innovation theory has been applied across numerous contexts. As we continue to apply this model within Extension education, international development, and other community education contexts around the world, it not only becomes pertinent to examine how it applies towards social innovations – innovations that improve the social good – but also to understand how communities react when adopting social innovations. Within this article, researchers propose an Emotional-Behavioral Influence Model to deepen the understanding as to how communities respond, emotionally and behaviorally, towards social innovations throughout the adoption process. They then overlay the model onto two examples, one urban and one rural, showcasing its application to communities worldwide. Finally, researchers discuss implications for extension professionals as they reflect on implementing social innovations in communities globally.

Keywords: Diffusion of Innovation theory; flow; communities; downshifting; social innovation
Introduction

The concept of diffusion of innovations has been around for nearly 70 years. For many individuals, especially those who were a part of a United States-based Agricultural Education higher education program, this theory was considered fundamental to our training. This makes sense, as research on diffusion of innovations began in Iowa in the early 1950’s with regards to agricultural innovation. Originally supported by the Iowa Agricultural Experiment Station, this diffusion research focused on developing hybrid seed corn and other agricultural innovations (Rogers, 2003). For Everett Rogers, generally considered the father of this theory, this research developed into his dissertation in 1957 – with an analysis of the diffusion of several agricultural innovations in the rural community of Collins, Iowa. It was during his dissertation when a pivotal moment shifted his paradigm on how individuals think about change, which Rogers shares with us: “I (Rogers) was convinced that the diffusion of innovations was a kind of universal process of social change.” (p. xvi, 2003).

Throughout the years, diffusion of innovations has been applied across a variety of contexts; as aforesaid, originally it was utilized within natural science and agricultural science applications. There are a variety of other contexts in which it has been applied – public health, nursing, technology and education to name a few (Andrews, Tonkin, Lancastle & Kirk, 2014; Beets, Flay, Vuchinich, Acoc, Li & Allred, 2008; Frank, Zhao, & Borman, 2004). What’s more, it continues to play an important role within Extension education, international development, and other community education contexts around the world (Rodriguez, Roberts & Harder, 2018; Scott, Weeks & Weeks, 2018). As we continue to utilize this model towards the diffusion of innovations, it becomes important to consider not only how this model is applied towards social innovations, but also how does a group – such as community – react when applied within the model? It begs the question – How do communities respond, emotionally and behaviorally, towards social innovations?

The Basics of Diffusion of Innovation

To apply the theory in a new or novel way, first we must undertake a thorough discussion about the model. However, as this discussion is specifically focused on what occurs during the innovation adoption process, we will limit this discussion to a few basics and the adopter categorizations. As defined by Rogers (2003), diffusion is the process where an innovation is communicated through specific channels over time, amongst the members of a social system. Within the diffusion of innovations process, there are four primary elements that can be identified in any diffusion campaign or program. These elements are:

1. An innovation – a idea, practice or object that is perceived as new or novel by an individual or other unit of adoption (i.e. organizations, communities, etc.);
2. Communication channels – the means by which messages get from one individual to another. This includes both mass media and interpersonal channels;
3. Over time;
4. Among members of a social system – a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members of a social system may be individuals, organizations or communities. (Rogers, 2003)

Throughout the diffusion process, communication is utilized by community
members within the social system to create and share information, in order to reach a collective understanding. Specifically, the communication occurring is about a new or novel idea (innovation); this impacts the overall process, because as with anything that is new, with novelty comes uncertainty, which adds complexity. Finally, some individuals claim that diffusion can include the unplanned, spontaneous spread of novel ideas; Rogers accepts this perspective, and thus includes both planned and spontaneous spread of new ideas within the overall idea of diffusing innovations.

It is throughout the diffusion process that community members determine if they will or won’t adopt the innovation; for those who decide to adopt, there is a relative timeline of adoption (see Figure 1 below).

**Figure 1.** Adopter Categories in Regard to Innovativeness (Rogers, 2003). Online figure modified by authors. NOTE: (x) = mean; sd = standard deviation

In order to standardize and clarify the different patterns or trends within adoption of innovations, Rogers (2003) separated adopters into five different categories, based upon innovativeness of the entity, or the degree to which an individual or group is relatively earlier in adopting a novel idea than other members within the social system. The resulting categories are based upon a normal frequency distribution and are outlined below:

1. **Innovators** – area lying to the left of the mean time of adoption (critical mass) minus two standard deviations; *is the first 2.5% of the individuals in a system to adopt an innovation.*

2. **Early Adopters** – are included in the area between the mean minus one standard deviation and the mean minus two standard deviations; *these are the next 13.5% of individuals in a system to adopt an innovation.*

3. **Early Majority** – make up the area between the mean time of adoption and the mean minus one standard deviation; *are the next 34% of individuals in a system to adopt an innovation.*

4. **Late Majority** - are included in the area between the mean and the mean plus one standard deviation; *are the next 34% of individuals in a system to adopt an innovation.*
5. **Laggards** - area lying to the right of the mean plus one standard deviation; are the last 16% to adopt the innovation.

Adopters within each of the five adopter classifications share general characteristics associated with innovation adoption; and even though these categories are considered ideal types, there are exceptions. Finally, the adopter categories are exhaustive, except for nonadopters.

Traditionally, individuals are the units of analysis when determining an innovation’s adoption timeline; however, this proves to be problematic when considering innovation adoption in the organization or community setting. Thus, researchers began basing the group’s (organization or community) innovative adopter category on who makes the innovation-decisions in that system. For an organization, it might be the CEO or Executive Board; within a community, this could be the Mayor, Judge Executive or community governing body. Whatever the group, it is important to realize who is making the innovation-decisions for the organization or community.

**Social Innovation**

According to Phills, Jr., Deiglmeier, and Miller (2008) social innovation is a new solution to a social issue that is more effective, efficient or fair than current solutions and for which the value created benefits society as whole rather than specific individuals. Innovation, within a general context, is a novel idea or solution that creates value for others. The computer has dramatically enhanced individual productivity and creativity. Pharmaceutical drugs save lives. High speed trains connect families and communities, while also enhancing individual freedom. So, while it could be argued that most innovations have social benefits, they wouldn’t necessarily be considered a social innovation. An innovation is truly a social innovation only if the balance is shifted toward the social good – which benefits society as a whole. Social innovation becomes particularly salient when markets fail and is utilized to create value that would not otherwise be created. Phills, Jr., Deiglmeier, and Miller (2008) go on to argue that social innovation itself is the best construct for understanding, and ultimately producing, long-term social change.

Social innovations can provide particular benefit within today’s communities. Many important social issues can’t be solved without collaboration between the nonprofit, public and private sectors (Phills, Jr., Deiglmeier, & Miller, 2008). In addition, communities provide a venue for individuals to learn and adapt in, as well work collaboratively towards improving the social good. Thus, it is not only critical to think of who is making the innovation-decision, but also how the community will ultimately respond to the adoption of the innovation. This provides the platform for our discussion and begs the question - “How do communities respond, emotionally and behaviorally, towards social innovations?”

**Conceptual Framework**

As individuals interact with the world, they assess life events and situations based on their significance to the individual’s provoked emotional valence (positive or negative emotions) and well-being (Lazarus, 1991; Scherer & Moors, 2019). This primal, cognitive assessment is the precursor for behaviors related to Rogers’ (2003) early and late innovation adoption. Those who perceive the event as a threat tend to experience negative emotions, often rejecting the innovation. Contrarily, people who perceive the event as a benefit often embrace the innovation and become
early adopters. It is with this understanding that we argue, communities, in addition to individuals, respond similarly when faced with social innovative events/situations. Throughout our article we focus specifically on social innovations as they are considered pertinent to international extension and global communities (Adam & Westlund, 2013). However, to fully examine this concept, we must first examine the underlying theories supporting our assertion. Thus, we examine three theories: appraisal theory, downshifting, and flow theory.

Appraisal Theory

An individual's cognitive evaluation of a life event and its correlating emotion are frequently identified as an “appraisal.” Appraisal theory is founded on the assumption that when faced with a novel event/situation (stimulus) emotions are provoked and differentiated based on individual evaluation (Sherer, 1999; Scherer & Moors, 2019; Smith & Kirby, 2009). One’s appraisal is inclusive of a number of criteria categorized into four classes:

1. Intrinsic characteristics of objects, such as novelty or agreeableness.
2. Significance of the event for the individual’s needs or goals.
3. Individual’s ability to influence or cope with the consequences of the event, including the evaluation of “agency.”
4. Compatibility of the event with social or personal standards, norms, or values (Sherer, 1999, p. 638).

While appraisal theory focuses on one’s initial evaluation, there are more complex cognitive processes that lead to correlating behaviors. To further understand these processes, we pose the question, “What cognitive processes are initiated when the stimuli are perceived as either threatening or non-threatening?”

Downshifting – Negative Appraisal

Once a person perceives an event/situation as being threatening, they experience a phenomenon known as “downshifting.” Hart (1983) identified downshifting as a behavioral outcome from biological coping processes. For example, when an individual detects a threatening situation, “full use of their brain is suspended and faster-acting, simpler brain resources take larger roles” (Hart, 1983, p. 108). Hart’s theory is associated with MacLean’s Triune-Brain theory. MacLean (1990) theorized that human brains have evolved into three interrelated yet separate components, the R-complex, the limbic system, and the neocortex.

Hart (1983) suggested that when events or situations evoke intense negative emotions, the brain defaults to the R-complex or reptilian complex. As a result, individuals often freeze up, are unable to speak or communicate as they would normally and may become nauseous, physically ill, or shake profusely when asked to perform a task. Additional behaviors can include evasive or aggressive responses toward a perceived threat, or primal behaviors such as territoriality, ritualistic display, “nesting”, and “flocking” (Caine & Caine, 1993; Hart, 1983; MacLean, 1990).

Appraised events provoking emotional intensity strong enough to trigger the limbic system also impact a person’s ability to process information. Behaviors triggering the limbic system can include stuttering, short-term loss of vocabulary, and evasive play behaviors or behaviors initiated to avoid the perceived threat (Hart, 1983).

The neocortex is the largest of the three evolved brains and is responsible for language communication and writing as well
as logical and operational thinking (Caine & Caine, 1993). The neocortex is able to assess scenarios of threat more accurately than the quick responses of the R-complex and limbic system, often suppressing primal responses according to the appraisal (Hart, 1983). In the absence of threat, full use of the cerebral brain is enacted, increasing the potential for learning and engagement (Hains, 2007; Hart, 1983). We discuss this scenario further in the following section.

While Hart (1983) and Hains (2007) examined this theory on an individual level, we argue that these behaviors are also often seen within communities. For example, community members may exhibit R-complex or limbic behaviors during an election or local governance results, if they perceive the results are negatively impacting them or the communities in which they live. This type of behavior is also common in communities of practice such as during a professional strike or union conflict. While downshifting provides insight on negatively appraised events, we will now explore the cognitive processes associated with positive appraisals.

Flow - Positive Appraisal

Whereas the theory of downshifting assists in understanding behaviors resulting from negative appraisals, it does not fully explain behaviors associated with positive appraisals. To do this, we examine flow theory. Csikszentmihalyi (1975) introduced the concept of flow as the phenomenon of being in an optimal cognitive state within a social context for a period of time. More specifically, Nakamura and Csikszentmihalyi (2001) identified six characteristics of flow:

1. Intense and focused concentration on what one is doing in the present moment;
2. Merging of action and awareness;
3. Loss of reflective self-consciousness (i.e., loss of awareness of oneself as a social actor);
4. A sense that one can control one’s actions; that is, the sense that one can deal with the situation because they know how to respond to whatever happens next;
5. Distortion of temporal experience (typically, a sense that time has passed faster than normal); and
6. Experience of the activity as intrinsically rewarding. (p. 90)

So, what happens when members of a community appraise a social innovation as being favorable? If it aligns with their social norms and values and they have the resources to implement the innovation, is it possible for them to enter a state of community flow? Could this lead to early adoption? It is questions such as these that need to be answered within a community context. To fully showcase the interface of these theories the following conceptual model was developed (see Figure 2 below).

Summary

Appraisal of a new event or situation happens instantaneously, provoking positive or negative emotions. Depending on the appraised emotional valence, positive or negative, it can initiate a series of behaviors that influence innovation adoption. This is especially true with social innovations in communities of place (geographic locale) or practice (professional community). If a majority of community members perceive the innovation as negatively influencing them and their community (place or practice), it can lead to negative behaviors resulting in late adoption or no adoption at all. However, if the majority of the community perceive the innovation as being
positive to them and their community, it could potentially lead to early adoption. In either case, community members who have appraised a social innovation with minimal threat or benefit, may be persuaded by other community members whose appraisal evoked a stronger emotional intensity.

**Emotional-Behavioral Influence Model**

<table>
<thead>
<tr>
<th>Instantaneous/short-term response</th>
<th>Knowledge Individual Beliefs &amp; Values</th>
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</thead>
<tbody>
<tr>
<td>Stimulus (Situation or Event)</td>
<td>[Anticipated/Unanticipated] [Frequency/Duration]</td>
</tr>
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</table>
| Stimulus Appraisal               | • Perceived novelty or agreeableness of objects or event.  
|                                  | • Individual significance to needs or goals.  
|                                  | • Ability to influence or cope with the consequences of the event, including the evaluation of “agency”.  
|                                  | • The compatibility of the event with social or personal standards, norms, or values. |
| Emotional/Behavioral Response    |                                        |
| Enhanced Cognitive Processing    | (Positive Emotional Intensity)          |
| Diminished Cognitive Processing  | (Moderate Negative Emotional Intensity) |
| Primitive Cognitive Processing   | (Intense Negative Emotional Intensity)  |
| • Full Verbal Communication      |                                        |
| • Clear Cognitive Articulation   |                                        |
| • Enhanced Creative Aptitude     |                                        |
| • Physical and Verbal Expression of Tertiary Emotions | |
| Diminished Verbal Communication  |                                        |
| • Increased Non-Verbal Communication/Actions | |
| • Physical and Verbal Expression of Basic and Secondary Emotions | |
| Behavioral Reflection            |                                        |
| Motivational Response            |                                        |
| Action                           | Attitudinal Change                     |
| Apathy                           | Minimal or No Attitudinal Change        |
| Disengagement                    | Oppositional Attitudinal Change        |

Figure 2. Emotional/Behavioral Model of Influence (Adapted from the Model of Emotional Influence, Hains & Knobloch, 2013).

**Social Innovation: A Conceptual Application**

To better answer our initial question, “How do communities respond, emotionally and behaviorally, to social innovations?” we overlay our conceptual model on two examples. The first highlights opportunities for extension professionals working in urban communities to apply the conceptual model utilizing a pertinent and controversial illustration. The second highlights a unique model of rural development for our international extension colleagues.

**Example One – The American Civil War & Contemporary Role of Urban Extension**

**Background & setting.** The setting for our first example is a southern city within the United States during the Civil War. Within the South, the city is
considered to be a “transitional city”. A transitional city is one where men fought for both sides of the U.S. Civil War (1861), the Union and the Confederacy. The war literally tore the city, and many of its families apart resulting in social and political torment. While the war ended in 1865, it would have substantial impact on the cultural and political development of the city and its citizens for generations to come.

Fast forward one hundred years later, Confederate officers have been honored for by the raising of permanent statues within the city’s center, causing generational unrest for community members who were descendants of slaves and those whose ancestors fought for the Union. In 2018, the generational turmoil came to a head with a social movement. There were two distinct sides to this social movement - those influenced by slavery and the fight to end slavery, and those whose ancestors fought for the Confederacy and who were southern sympathizers.

Social innovation. The movement to remove the Confederate statues, in front of a prominent building and center of the city, began as a flashmob. As the movement gained momentum protestors began demonstrations, eventually they established an informative booth at local events assisting them in collecting supporter signatures (Musgrave, 2017). All this took place on the grounds of the former slave auctions where the statues also stood.

Even through community criticism, leaders of the movement continued to educate the general public, met with local leaders, participated in several public events and attended numerous civic meetings. After two years, their persistence paid off with the removal of the Confederate statues in the middle of the night.

Community emotional/behavioral responses.

Innovators/Early Adopters – Flow. There were a large number of community members in support of the movement to remove the Confederate statues. Early adopters within the community viewed the innovation as highly relevant to contemporary society, their initial appraisal aligned with their personal norms and values and they were in favor of the cultural change (Scherer, 1999). They supported the leaders of the movement instantaneously and worked to convince community members who were unsure to support the movement. These individuals attended community functions, civic meetings and signed petitions to sustain the movement. They also provided the verbal and moral support to keep the leaders, who were unsure of their progress, going during the process. These individuals were passionate and felt that the presence of Confederate statues in a prominent area of the city that was a place for slave auctions was ludicrous and did not represent the 21st century community in which they lived.

Early adopters in this situation exhibited a form of communal “flow.” In other words, they went above and beyond their normal civic behavior as a result of their commitment and passion toward the movement. They exhibited several factors associated with flow theory as proposed by Nakamura and Csikszentmihalyi (2001): intense and focused concentration on what one is doing in the present moment; experience of the activity as intrinsically rewarding, such that often the end goal is just an excuse for the process; a sense that one can control one’s actions; that is, a sense that one can in principle deal with the situation because one knows how to respond to whatever happens next; and merging of action and awareness.
Early Majority Adopters.
Community members who were minimally or unaffected by the movement were indifferent or moderately aware of the situation. These individuals were most at risk to be swayed by passionate individuals on both sides of the issue. As such, several of the early adopters worked to appeal to the moral and ethical fibers of the majority. This, in fact, did sway those who were undecided on the issue and influenced several to be in support of the removal.

Late Adopters/Laggards/Opposers.
As often exists with social innovations or movements, there are sectors of the community who are reluctant to the innovation or even in direct opposition. Many in the late adopters/laggards/opposer group viewed the removal of the statues as a threat to their culture and ancestry. As such, they also attended public functions, civic meetings, posted on social media and signed petitions in opposition of the movement. They too appealed to the late majority adopters using cultural heritage as a context to sway their perspective. In fact, some extreme opposers used violent threats and intimidation tactics to inhibit the movement and sway opinions (Musgrave, 2017).

This negative appraisal of community members provides a great example of downshifting behaviors (Hains, 2007). Protestors exhibited behaviors such as territoriality, ritualistic display, “nesting”, and “flocking” (Caine & Caine, 1993; Hart, 1983; MacLean, 1990). Additionally, extremists in the community used aggressive fight or flight behaviors to intimidate leaders of the movement and thwart its momentum. However, even the late adopters and laggards had to begrudgingly, succeed to the social innovation over time.

Example Two – Isle of Gigha: A Scottish Social Innovation

Background.
Just off of the west coast of Scotland, you will find a small island known as Gigha. Marked by a beautiful landscape, Gigha can most certainly be characterized as the islanders’ “little piece of paradise.” The peace and beauty of the Isle, however, belies much of the struggle this small island had seen over the last decades.

Gigha, like several island on the Inner and Outer Hebrides, exhibited remanence of the feudal system until rather recently. For instance, Gigha was owned and managed by one landowner or laird, who oversaw the island’s development. Under this system, the villagers paid rent to the landowner to stay and work on the laird’s property (Isle of Gigha, 2019). However, in return, the laird was obligated to maintain the island and the village.

Social innovation.
In 2002, after centuries of sole ownership, the small island was offered the opportunity to become a “community-owned” island, rather than operating under a laird, or other absentee landowner. The community took this opportunity and became one of the first community-owned islands in Scotland. Gigha residents raised $2,000,000 (as a community) to purchase the island from the laird. What followed was a mixture of success, failure and a variety of social innovations in the discovery of who it is as its own, self-governed community.

Community emotional/behavioral responses.

Innovators/Early Adopters – Flow.
There was great solidarity in the Gigha community as they worked diligently to raise funds and finally purchase their island. People worked with other agencies and put in countless hours to make the vision become a reality as it would provide more
leadership stability, ability to control its own decisions (and ultimately its destiny), the opportunity to bring new businesses to the island that would help to grow the community – becoming community owned would bring with it much more responsibility and work for its community members.

It is evident that a vast majority of the community appraised the event, purchasing their island, as being quite positive. As a result, the residents entered a state of communal flow (Nakamura & Csikszentmihalyi, 2001), working meticulously to create the resources needed to accomplish their goal. Furthermore, their relationships only strengthened as they were focused on a common vision.

**Early Majority Adopters.** Those who had been conditioned by centuries of laird ownership exhibited signs of hesitation, not knowing the community’s future as this was quite innovative for the time. However, over time they too began to embrace the idea of community ownership and began to join the innovators and early adopters in their initiative.

**Late Adopters/Laggards/Opposers.** While the majority of the Gigha community were in full support of the island’s purchase, there were a few in opposition and negatively appraised the situation. These individuals understood the benefits of having a laird (family or person) who owns the island. If something went wrong with the islands’ infrastructure or community it was the laird’s responsibility to fix it. Additionally, there was always the laird to blame if the community did not like decisions that directly impacted their community.

However, when the community assumed responsibility for the island, they became responsible for the community’s infrastructure and future. The immediate responsibility initially caused frustration among the community and many residents exhibited behaviors associated with downshifting such as nesting and flocking as social cliques, short-term loss of vocabulary in public conflict, and evasive play behaviors or behaviors initiated to avoid the perceived threat (Hart, 1983). These behaviors reinforced the laggards and opposers position on the social innovation initially. However, over time, the community worked through the initial shock of community ownership and the laggards and opposers embraced the innovation.

Many years later, Isle of Gigha is still going strong. Many aspects have changed; the Housing Improvement Project has improved a majority of the houses on the island, bringing them up to standard while also adding several new homes. Eleven new businesses have been introduced onto the island since 2002, adding more jobs and encouraging the economic sustainability of the island; and the schoolhouse is fuller than it’s been in recent history, with 22 students on its rolls. Yet while not all the decisions that have been made over the last eight years may have been perfect, developing into a strong, viable community owned island is an accomplishment in and of itself.

**Summary**

Within both of these examples – domestic and international – clearly the emotional and behavioral responses impacted the experience of the overall community. Emotions (and resulting behaviors) of community members impacted how the community dealt with the change, communicated, developed shared values and ultimately made the final decision to innovate. Regardless of whether the community was an Early Adopter (Isle of Gigha) or a Late Adopter (Southern city), social innovation was felt by the community and its members.
Conclusions & Implications

Diffusion of innovations is a concept that continues to be utilized today in a variety of contexts; not the least of which is the context of Extension and community education. The application of this model isn’t necessarily unique or novel – however, utilizing it when addressing social innovations and considering the emotional or behavioral reactions to the innovation from a community standpoint is novel. As defined previously, social innovation’s unique “value added” is its impact upon the social good – as community educators around the world, we are continuously involved in projects and programs designed to provide positive impact to the communities we serve. In many cases we could be considered the designers of social innovations. Extension should be at the forefront of leading more social innovation; as such, there will be behavioral and emotional reactions to be expected from the communities they serve.

Rogers’ (2003) diffusion of innovations model can assist us in understanding how individuals may react in the adoption process. Rogers’ adopter categories give us a baseline from which to operate – Innovators all the way to Laggards. However, these categories illustrate innovation from an individual perspective; they don’t address innovativeness of a group. Understanding that a community is a group of individuals, and within the group there will be times where you experience early, mid and late adopters all at one time is particularly salient. As more recent diffusion research shares, it is important to realize who is the community decision maker, and base the group’s innovative adopter category on who makes the innovation-decisions in that system.

What’s more, is within the community setting there can be a variety of group emotional and behavioral responses occurring in reference to various social changes. Community members could experience positive communal “flow”, negative collective “downshifting” or potentially even group think. All of these collective emotional reactions not only affect the decision to adopt or reject a social innovation, but they can also have an impact on the community in general. This is why it is critical to not only understand the emotional/behavioral process, but also basic tenets of group facilitation and community development.

It could be argued that in traditional Extension circles, there tend to be more Late Adopters than Innovators or Early Adopters. This is not unusual in more traditional fields. Within today’s society, it is especially important to remain relevant. This perspective becomes the stimulus for Extension to downshift or adopt; innovate or not. In a world where community education can do so much good, there is a need for more social innovations. By considering these various examples and thinking through the types of potential community responses prior to introducing the innovation (preflection), considering the Emotional-Behavioral Influence Model may help in establishing more early adopters. This, in turn, could lead to a more successful adoption process and community transition. As we introduce more social innovations, we need to be cognizant of the behavioral and emotional impacts it will have on our communities. This would improve our overall relevance and help move us into the future.

Rogers (2003) concludes the introduction to his book with this insight:

Throughout this book I seek to represent a healthily critical stance. We do not need more-of-the-same diffusion research. The challenge for
diffusion scholars of the future is to move beyond the proven methods and models of the past, to recognize their shortcomings and limitations, and to broaden their conceptions of the diffusions of innovations. (p. xxi)

Even revisiting this work over 15 years later, this statement still proves to be particularly poignant. The purpose behind all of this wasn’t to reach an endpoint – it was instead to continue pushing the envelope and expanding how to apply model itself. And it is in this spirit that we forge ahead and encourage pushing the creatives juices of future diffusion of innovation practitioners and scholars.

References
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Testing a Model to Explain how the Public Makes Decisions about Genetic Modification

Alexa J. Lamm  
Kevan W. Lamm  
University of Georgia

Joy N. Rumble  
Ohio State University

Jason D. Ellis  
Kansas State University

Abraham Tidwell  
University of Georgia

Abstract

The international agricultural and extension education field is fairly infantile in its research approach with descriptive, exploratory and process-oriented research taking the forefront over the introduction and testing of theoretical models that strive to answer complex questions. In a time when the world is facing a myriad of global challenges directly related to the agricultural and natural resource system (e.g. food security, climate change, infectious disease management) the discipline must be bold, innovative, and discovery-driven. The research presented here tests a theoretical model that combines two well-known theories, Diffusion of Innovations and Spiral of Silence, in the context of examining public willingness to expose attitudes about genetic modification (GM) in the United States. Structural equation modeling is used to determine the direct and indirect effects theoretical variables can have in a complex decision-making environment. Perceptions of diffusion characteristics of an innovation were found to directly and indirectly effect perceived opinions of others, perceived future trends in attitudes toward GM, and attitude toward GM but they did not have a significant direct or indirect effect on willingness to expose attitudes about GM. The findings revealed the ongoing complexity associated with systems-thinking and the research approaches necessary to answer complex questions. It also showcased that when thoroughly vetted theoretical explanations are tested, they will not always have the expected result.

Keywords: systems thinking; decision-making; diffusion; spiral of silence
Introduction

Scholars in the international agricultural education, communication, extension, and leadership disciplines have been examining decision making, trust in science, and consumer perceptions in the context of agricultural and natural resources for some time (e.g. Lamm, Warner, Taylor, & Martin, 2017; McKee, Lamm, & Bunch, 2017; Sanok, Stripling, Stephens, Griffith, 2015; Rumble, Chiarelli, Culbertson, & Irani, 2014; Rumble et al., 2019). While many of these studies add to the literature given the ANR context, they often fail to create and test proposed theories and models (Irani & Doerfert, 2013). The young and evolving nature of the discipline, in comparison with parent disciplines like education, psychology, and sociology, has been reflected in common descriptive, exploratory, and process-oriented research (Irani & Doerfert, 2013). The applied nature of our field also creates an environment suitable for simpler research processes (Irani & Doerfert, 2013; Lindner, 2018). However, as ANR issues become more complex and controversial, there is a need for our discipline to become more innovative, collaborative, and discovery-driven in our approaches to research (Irani & Doerfert, 2013). In this manuscript, we seek to make advances in the testing and validation of a theoretical model to help explain and predict decision making on complex ANR issues. A model of this nature could aid in the development of effective education, communication, and outreach approaches for complex ANR issues.

Globally, discussion has focused on grand challenges (United Nations, n.d.). “Grand challenges are ambitious but achievable goals that harness science, technology, and innovation to solve important national or global problems and that have the potential to capture the public’s imagination” (Office of Science and Technology Policy, n.d., para. 1). Many grand challenges, such as food security, rural development, sustainability, climate change, and infectious disease management, intersect the agricultural and natural resource disciplines. Furthermore, grand challenges can benefit from social, human, and leadership capacity offered by disciplines such as ours (Linder, 2018). For example, we know that public decision making about agricultural and natural resource issues is complex and multi-dimensional (Trowler, 2012). Understanding the emotion, ethics, morals, and politics that impact personal decision making (Cook, Pieri, & Robbins, 2004) becomes integral to translating scientific solutions to real-world solutions that are accepted by the public.

Genetic modification (GM) is one agricultural breakthrough that scientifically could have positive implications for the grand challenge of food security (Maghoub, 2016). The implications and success of GM, however, have been hindered throughout the world by regulatory and consumer acceptance challenges (Lusk, Jamal, Kurlander, Roucan, & Taulman, 2005; Maghoub, 2016). Numerous studies have documented negative attitudes and lack of acceptance toward GM food (Funk & Rainie, 2015; Maghoub, 2016). Also well documented are the arguments against and concerns surrounding GM (Mahgoub, 2016), but missing from the literature is a scientific and tested understanding of why individuals have made decisions against GM. Several studies have attributed lack of acceptance to perceptions of risks (Boccaletti & Moro, 2000; Chen & Li, 2007; Curtis & Moeltner, 2006; Lusk & Coble, 2005; Mahgoub, 2016; Rosati & Saba, 2000; Scholdere et al., 1999) but depth of understanding related to the decision-making process is missing. In this study, we seek to not only test a theoretical model to help explain and predict decision making on complex ANR issues, but also
understand specifically how the model explains decision making related to GM. Understanding decision making of this controversial issue will provide communicators, leaders, and educators with information to help build capacity around the next innovation and lead to scientific and social success in addressing grand challenges.

**Conceptual Framework**

Ruth, Rumble, Lamm, Irani, and Ellis (2018) introduced a conceptual model for decision-making about ANR science and technology, combining the Theory of Diffusion (Rogers, 2003), the Spiral of Silence (Noelle-Neumann, 1974), and the Elaboration-Likelihood Model (Cacioppo & Petty, 1984; Perloff, 2014). The model (Figure 1) outlines a framework for examining how individuals enmeshed in the complexities that arise from navigating complex and often competing sources of information about ANR science and technology make sense of and express their views, and how these views can be modulated through persuasive messaging. The Ruth et al. (2018) model posits that individuals establish perceptions of a given ANR science or technology and its attributes through Roger’s five characteristics of an innovation: (a) relative advantage, (b) compatibility, (c) complexity, (d) triability, and (e) observability. Each factor can have a different impact on an individual's attitude toward a given technology; for example, Ruth et al. (2016) noted compatibility was the only factor that explained a group of college students’ willingness to consume genetically modified citrus. Which factors explain perception and attitude toward a given ANR technology vary based on several demographic and cultural factors: gender, race, age, socio-economic status, and culture of origin (Weick & Walchi, 2002). The Ruth et al. (2018) model in turn treats each factor as a separate explanatory variable and their interactions as related, but not linked to one another.

Social and cultural factors, expressed through and in tandem with the five characteristics of an innovation outlined by Rogers (2003), influence how individuals approach their larger social world and make sense of which forms of discourse are acceptable within a given group in society and which ones are not acceptable. Following Noelle-Neumann’s Spiral of Silence (1974) theory of public opinion formation, the ANR model outlined by Ruth et al. (2018) posits that two of the three key factors of the spiral of silence, perceived opinions of others and perceived future trends of others’ attitudes, are formed in conversation with how an individual situates personal views within their immediate social groups and the self-perceived majority. Individuals within a given society must navigate how their personal views align with the shared imperative of maintaining cohesion, or risk social isolation (Noelle-Neumann, 1974). Media packages play a critical role in creating and reinforcing the spiral of self-confirming views, or what Scheufele, Hardy, Brossard, Waismel-Manor and Nisbet (2006) called the echo chamber. This phenomenon has become more pronounced as the wealth of media options enables individuals to find social groups in alignment with their viewpoints that do not necessarily reflect national priorities and values (Glynn & Park, 1997; Slater, 2007). Individual viewpoints, mediated through perceptions of future attitudes and existing attitudes of others within their social groups, shape an individual's attitude and his or her willingness to expose said attitude to others.
An attitude, however, is not an immobile object within the model but rather a place where discourse can begin between an individual mediated in his or her social milieu and alternative messaging. Drawing on persuasive communications theory, the model of Decision-Making for ANR Science and Technology finds the Elaboration-Likelihood Model (ELM; Petty et al., 1995) provides an effective framework to explain how messaging interacts with existing attitudes and willingness to expose such attitudes in shaping how an individual analyzes new information and comes to either the same, or a different, conclusion. Elaboration-likelihood is a process-probability model: the framework rests on explicating when an individual will carefully explore the implications of new messaging or rely on existing knowledge and social norms/values (Perloff, 2014).

Individuals presented with new messaging who explore and examine the new message and its implications within their existing knowledge and value systems carefully weigh the quality of messaging, who is providing the message, and the social forces that are influencing their expressed viewpoint (Bhattacherjee & Sanford, 2006). Individuals who experience a change in attitude through careful examination of messages experience what Petty et al. (1995) call a “central” change or core shift in viewpoint. Such “central route” transformations in attitude create the conditions by which sustained change in behavior is possible. By contrast, those who do not explore and examine new messages in depth – what the ELM model refers to as
“peripheral route” processing (Perloff, 2014) – tend to rely on manifestly less issue-focused factors, such as the likeability of the person providing a message, or other factors not immediately related to the message itself. Changes in attitude through peripheral route processing are not as easily sustained.

Ruth et al. (2018) note the Decision-Making Model for ANR Science and Technology can play an important role in improving the processes and practices through which agricultural education can facilitate the adoption of new technologies. However, the model has yet to be formally tested and validated. While models are imperfect representations of reality couched in complex assumptions, the experience of researchers, and the shared knowledge of a community of practice, it is crucial such models are tested and their limits identified (McQuail & Windahl, 2013). This study seeks to address how two of the interacting components within the Ruth et al. (2018) model, diffusion of innovations and spiral of silence, explain a person’s willingness to express his or her views on ANR science and technology. To accomplish this, we turn to a highly visible and polarizing arena of discourse: the application of GM technologies to agriculture, or GM crops. Perceptions of GM agriculture vary considerably in different social and cultural contexts: according to Frewer et al. (2013), individuals’ perceptions vary based on their specific socio-cultural context(s). Finucane (2002) argued that tailoring communication strategies to a specific group’s views on risk, trust, new technologies, and the world at large is necessary to achieve a fuller understanding of the role GM agriculture can play globally.

Testing the Decision-Making Model for ANR science and technology with attention to an individual’s willingness to expose attitude toward GM requires a few clarifying modifications to the original model. The five characteristics of diffusion adopted from Rogers (2003) should have separate causal relationships (Figure 2).

While the original model treated each factor as separate and proposed using quantitative and qualitative measures, in this study we argue it is crucial our model makes clear interdependencies or a lack thereof to maximize replicability, especially since it is only using quantitative measures. Similarly, Attitude toward ANR science and technology is now situated between the two Spiral of Silence factors – Perceived Future Trends and Perceived Opinions of Others. This modification achieves a better representation of the relationship between perception and willingness expressed in the original Spiral of Silence theory. Finally, as our analysis focuses on an individual’s willingness to expose attitudes toward ANR science and technology specifically GM, the Willingness to Expose Attitudes variable has been moved down between individual attitude and the interaction variable marked by an “X” in Figure 1.
Figure 2. Adapted Decision-Making Model for ANR Science and Technology.

**Purpose & Objectives**

The purpose of this research was to test the first two components of the model (perceived Diffusion characteristics and Spiral of Science attributes) using GM as the ANR science of interest. It was guided by the following objectives:

1. Describe respondents’ perceptions of the five Diffusion characteristics related to GM.
2. Describe respondents’ perceptions of the Spiral of Silence attributes related to GM.
3. Identify the direct and indirect effects of the perceptions of the five Diffusion characteristics related to GM and perceptions of the Spiral of Silence attributes related to GM on Willingness to Expose Attitude toward GM.

**Methods**

The study was part of a larger research project undertaken to identify the most effective communication and education strategies that could assist in garnering public acceptance of GM as a potential
solution to Huanglongbing (citrus greening disease).

Data Collection

The population of interest was members of the adult U.S. population. Using non-probability opt-in sampling, data from 1,046 respondents representative of the U.S. population were obtained using an online survey. Since this technique is most often used to make population estimates (Baker et al., 2013), it was deemed as the most ideal sampling method to meet the objectives of the study. Limitations associated with non-probability opt-in sampling include introducing bias from under coverage and nonresponse (Lamm & Lamm, 2019). In addition, selection bias also can occur based on the type of person that would opt-in to complete a survey online (Lamm & Lamm, 2019). However, research has shown “non-probability samples have yielded results that are as good as, or even better than, probability-based samples when appropriate techniques are employed to overcome its limitation” (Lamm & Lamm, 2019, p. 55). Quota sampling was applied (Moser & Stewart, 1953) prior to data collection. Weighting, based on the 2010 census data, was used after data collection was completed to ensure the sample was representative of the population of interest (Baker et al., 2013).

Instrument Development

Three parts of the survey were used to achieve the research objectives: perceptions of the five Diffusion characteristics (Rogers, 2003), perceptions of the Spiral of Silence attributes (Noelle-Neumann, 1974), and Attitude toward GM. Indices were created using the average response from multiple items for each of the five Diffusion characteristics, the three Spiral of Silence attributes and Attitude toward GM. Details on the number of items making up each indice and reliability statistics determined post hoc can be seen in Table 1.

Table 1

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<td>Relative Advantage</td>
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<td>.92</td>
</tr>
<tr>
<td>Compatability</td>
<td>6</td>
<td>.77</td>
</tr>
<tr>
<td>Trialability</td>
<td>5</td>
<td>.76</td>
</tr>
<tr>
<td>Complexity</td>
<td>6</td>
<td>.83</td>
</tr>
<tr>
<td>Observability</td>
<td>6</td>
<td>.92</td>
</tr>
<tr>
<td>Perceptions of future trends</td>
<td>7</td>
<td>.89</td>
</tr>
<tr>
<td>Perceived opinions of others</td>
<td>8</td>
<td>.97</td>
</tr>
<tr>
<td>Willingness to expose attitude toward GM</td>
<td>7</td>
<td>.80</td>
</tr>
<tr>
<td>Attitude toward GM</td>
<td>8</td>
<td>.97</td>
</tr>
</tbody>
</table>

a Scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree 5 = strongly agree
b Scale: 5-point semantic differential scale with 1 = low, 5 = high
c Scale: 5-point semantic differential scale with 1 = negative, 5 = positive.

Relative advantage was measured by requesting respondents indicate their level of agreement with eight items on a five-point Likert-type scale. Example items include:
GM science enhances the taste of food, GM science reduces the use of pesticides and GM science is part of a solution to end world hunger. Compatibility was measured by requesting respondents indicate their level of agreement with six items on a five-point Likert-type scale. Example items include: Developments in GM science help make society better, GM science is essential for improving the quality of human lives, and GM science makes our way of life change too fast (reverse coded when the indice was created). Trialability was measured by requesting respondents indicate their level of agreement with five items on a five-point Likert-type scale. Example items include: I can easily try food products that result from plants made with GM science, Food products that result from plants made with GM science are easy to try, and Food products that result from plants made with GM science are readily available for me to try.

Complexity was measured by requesting respondents indicate the level to which an adjective best represented their thoughts about GM science. They were presented with six sets of opposing adjectives on a five-point semantic differential scale. Example sets include: Complex/Simple, Clear/Unclear, and Confusing/Straightforward. Observability also was measured by requesting respondents indicate the level to which an adjective best represented their thoughts about GM science. Six sets of opposing adjectives were presented on a five-point semantic differential scale. Example sets include: Easy to identify/Difficult to identify, Evident/Concealed, and Visible/Invisible.

Perceptions of future trends were measured by requesting respondents indicate their level of agreement with seven items on a five-point Likert-type scale. Example items include: In the future, people will not worry about GM science; In the future, people will be supportive of GM science; and In the future people will be appreciative of GM science. Perceived opinions of others were measured by requesting respondents indicate the level to which an adjective best represented their thoughts about how others in the U.S. feel about GM science. They were presented with eight sets of opposing adjectives on a five-point semantic differential scale. Example sets include: Good/Bad, Positive/Negative, and Beneficial/Not Beneficial. Willingness to Expose Attitudes toward GM was measured by requesting respondents indicate their level of agreement with seven items on a five-point Likert-type scale. Example items include: I would enjoy a good discussion about GM science, I would worry about being isolated if the people I am talking to disagree with me about GM science, and I would readily participate in a group discussion about GM science. Finally, Attitude toward GM was measured by requesting respondents indicate the level to which an adjective best represented their thoughts about how they feel about GM science. They were presented with the same eight sets of opposing adjectives on a five-point semantic differential scale that were used to determine perceived opinions of others. Example sets include: Necessary/Unnecessary, Important/Unimportant, and Crucial/Trivial.

The survey was expert panel reviewed by an agricultural communication professor specializing in science communication, a genetics professor currently testing GM science as a potential solution to citrus greening, and an extension evaluation specialist who is considered an expert in survey design. After expert panel review, the survey was pilot tested on 100 undergraduate college students at the University of Florida and Kansas State University. Cognitive interviews were then
conducted with eight of the college students to determine face and content validity. Based on the reliability of the instrument during the pilot test and feedback obtained during the cognitive interviews, adjustments were made to one of the complexity items and two of the trialability items prior to full data collection.

Data Analysis

Descriptive statistics were used to achieve the first two research objectives using SPSS25. Structural equation modeling (SEM) was used to achieve the third objective. The Chi-square test of model fit was significant ($\chi^2 = 152.86, df = 16, p < .001$). Error terms associated with variables were allowed to correlate based on recommendations within the literature. Associated errors are allowed when items are conceptually associated or related to respondent relative answering based on item or stem preconditioning (McDonald & Ho, 2002; Saris & Aalberts, 2003).

Multiple model fit statistics were calculated in accordance with the recommendations in the literature (Hu & Bentler, 1998; Schreiber, Nora, Stage, Barlow, & King, 2006) to establish sufficiency of the model and data. Specifically, the comparative fit index (CFI), Tucker Lewis Index (TLI), and root mean square error of approximation (RMSEA) were computed. According to Hu and Bentler (1998), several benchmarks have been established to analyze model fit statistics and thus identify model misspecification. Specifically, the following thresholds have been proposed: RMSEA values less than 0.08 represent acceptable model fit; CFI and TLI values of 0.90 represent marginal fit, with values below 0.90 indicating poor fit and values 0.95 representing good fit. Model fit statistics were within acceptable ranges, indicating good fit for both CFI (.98) and TLI (.95). The other fit statistic, RMSEA (.09), was not within the established range for acceptable model fit. However, Schreiber et al. (2006) would find the model acceptable indicating that “if the vast majority of the indexes indicate a good fit, then there is probably a good fit” (p. 327).

Results

Perceptions of Diffusion Characteristics Related to GM

The respondents were neutral regarding the perceived observability of GM, complexity of GM, compatibility of GM, and trialability of GM. Respondents agreed GM had a perceived relative advantage. Details can be seen in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Perceptions of Diffusion characteristics related to GM</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Advantagea</td>
<td>3.59</td>
<td>.79</td>
</tr>
<tr>
<td>Compatabilitya</td>
<td>3.27</td>
<td>.71</td>
</tr>
<tr>
<td>Trialabilitya</td>
<td>3.27</td>
<td>.53</td>
</tr>
<tr>
<td>Complexityb</td>
<td>2.69</td>
<td>.78</td>
</tr>
<tr>
<td>Observabilityb</td>
<td>2.69</td>
<td>.98</td>
</tr>
</tbody>
</table>

*a Scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree 5 = strongly agree

*b Scale: 1 = low, 5 = high
Perceptions of the Spiral of Silence Attributes Related to GM

Respondents were neutral regarding perceived future trends and opinions of others; however, respondents agreed to exposing their attitude toward GM as seen in Table 3.

Table 3

Perceptions of the Spiral of Silence Attributes Related to GM

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness to expose attitude toward GM*</td>
<td>3.51</td>
<td>.73</td>
</tr>
<tr>
<td>Perceptions of future trends*</td>
<td>3.30</td>
<td>.83</td>
</tr>
<tr>
<td>Perceived opinions of othersb</td>
<td>2.98</td>
<td>1.08</td>
</tr>
<tr>
<td>Attitude toward GMb</td>
<td>2.69</td>
<td>1.02</td>
</tr>
</tbody>
</table>

*a Scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree 5 = strongly agree
*b Scale: 1 = negative, 5 = positive

Direct and Indirect Effects of Diffusion Characteristics and Spiral of Silence Attributes Related to GM on Attitude toward GM

The direct effects indicated that Relative Advantage, Compatibility, and Trialability were all positively related to Perceived Future Trends of positive attitudes toward GM (Table 4). Of the three, Compatibility had the largest effect (standardized coefficient = .49).

Table 4

Unstandardized, Standardized, and Significance Levels for Direct Effects

<table>
<thead>
<tr>
<th>Parameter Estimate</th>
<th>Unstandardized</th>
<th>Standardized</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Future Trends of Attitudes Toward GM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>← Relative Advantage</td>
<td>.24</td>
<td>.21</td>
<td>.00**</td>
</tr>
<tr>
<td>← Complexity</td>
<td>.02</td>
<td>.02</td>
<td>.22</td>
</tr>
<tr>
<td>← Observability</td>
<td>.02</td>
<td>.02</td>
<td>.30</td>
</tr>
<tr>
<td>← Compatibility</td>
<td>.56</td>
<td>.49</td>
<td>.00**</td>
</tr>
<tr>
<td>← Trialability</td>
<td>.19</td>
<td>.12</td>
<td>.00**</td>
</tr>
<tr>
<td>Perceived Opinions of Others</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>← Relative Advantage</td>
<td>.12</td>
<td>.09</td>
<td>.03*</td>
</tr>
<tr>
<td>← Complexity</td>
<td>.15</td>
<td>.11</td>
<td>.00**</td>
</tr>
<tr>
<td>← Observability</td>
<td>.30</td>
<td>.28</td>
<td>.00**</td>
</tr>
<tr>
<td>← Compatibility</td>
<td>-.01</td>
<td>-.01</td>
<td>.89</td>
</tr>
<tr>
<td>← Trialability</td>
<td>.19</td>
<td>.10</td>
<td>.01*</td>
</tr>
<tr>
<td>Attitude Toward GM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>← Perceived Future Trends of Attitudes Toward GM</td>
<td>-1.10</td>
<td>-.92</td>
<td>.00**</td>
</tr>
<tr>
<td>← Perceived Opinions of Others</td>
<td>-.38</td>
<td>-.39</td>
<td>.00**</td>
</tr>
<tr>
<td>Interaction Variable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>← Perceived Future Trends of Attitudes Toward GM</td>
<td>2.50</td>
<td>.46</td>
<td>.00**</td>
</tr>
<tr>
<td>← Perceived Opinions of Others</td>
<td>3.30</td>
<td>.74</td>
<td>.00**</td>
</tr>
<tr>
<td>Willingness to Expose Attitude Toward GM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>← Attitude Toward GM</td>
<td>-.02</td>
<td>-.03</td>
<td>.49</td>
</tr>
</tbody>
</table>
A total of 19.8% of the variance of perceived future trends of attitudes was predicted by the Diffusion characteristics (Table 5). The direct effects observed in the model indicated that four of the five Diffusion characteristics were positively related to Perceived Opinions of Others; Compatibility was not found to be related. Of the four remaining characteristics, Observability had the largest effect (standardized coefficient = .28). A total of 53.8% of the variance in the Perceived Opinions of Others was predicted by the Interaction Variable (Perceived Future Trends x Perceived Opinions of Others).

Table 5

<table>
<thead>
<tr>
<th>Spiral of Silence Attributes Related to GM</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Future Trends of Attitudes Toward GM</td>
<td>.198</td>
</tr>
<tr>
<td>Perceived Opinions of Others</td>
<td>.538</td>
</tr>
<tr>
<td>Interaction Variable (Perceived Future Trends x Perceived Opinions of Others)</td>
<td>.954</td>
</tr>
<tr>
<td>Attitude Toward GM</td>
<td>.306</td>
</tr>
<tr>
<td>Willingness to Expose Attitude Toward GM</td>
<td>.001</td>
</tr>
</tbody>
</table>

A graphical representation of the model resulting from the SEM analysis is shown below in Figure 3. Non-significant direct effects were removed from the original version shown in Figure 2 to aid in clarity and interpretation. Of particular note is the absence of direct effects associated with the Willingness to Expose Attitude Toward GM variable. Error terms, although not indicated in the figure, were present in the analysis.
The standardized indirect effects observed in the model are presented in Table 6. Of the five Diffusion characteristics, Compatibility (standardized coefficient = .219) and Observability (standardized coefficient = .217) had the largest significant indirect effect on the interaction variable (Perceived Future Trends of attitudes toward GM X Perceived Opinions of Others). A total of 95.4% of the variance in the interaction variable was predicted by the model, including both direct and indirect effects (Table 6).

Figure 3. Statistically significant direct effect results for the decision-making model. NOTE: CFI = .98; TLI = .95; RMSEA = .09; $X^2 = 152.86$; degrees of freedom = 16.

Significant negative effects were found for all five Diffusion characteristics on attitude towards GM. Of the five, compatibility (standardized coefficient = -.444) had the largest significant negative effect on attitude towards GM. A total of 30.6% of the variance in attitude toward GM was predicted by the model, including both direct and indirect effects (Table 6). Lastly, standardized indirect effects ranged from .002 to .012 between the five Diffusion characteristics and willingness to expose attitude toward GM. A total of 0.10% of the variance in the willingness to expose attitude
toward GM variable was predicted by the model, including both direct and indirect effects (Table 6).

Table 6

<table>
<thead>
<tr>
<th>Interaction Variable</th>
<th>Relative Advantage</th>
<th>Complexity</th>
<th>Observability</th>
<th>Compatibility</th>
<th>Trialability</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Perceived Future Trends x Perceived Opinions of Others)</td>
<td>.159</td>
<td>.094</td>
<td>.217</td>
<td>.219</td>
<td>.124</td>
</tr>
<tr>
<td>Attitude Toward GM</td>
<td>-.226</td>
<td>-.064</td>
<td>-.129</td>
<td>-.444</td>
<td>-.143</td>
</tr>
<tr>
<td>Willingness to Expose Attitude Toward GM</td>
<td>.006</td>
<td>.002</td>
<td>.003</td>
<td>.012</td>
<td>.004</td>
</tr>
</tbody>
</table>

Conclusions, Implications & Recommendations

The respondents expressed a neutral attitude toward GM overall and believed others had a more positive opinion of GM than they did, although still neutral. Several other studies have found negative attitudes toward GM, especially when it comes to food (Funk & Rainie, 2015; Maghoub, 2016). Therefore, this finding implies attitudes toward GM are not as negative as expected. The distribution of the respondents’ attitudes should be further examined to determine if attitude is normally distributed or if individuals are polarized on the subject and when responses are combined they look neutral overall. The large standard deviation would indicate variability exists and would warrant more exploration.

In aggregate, the respondents agreed they were Willing to Expose their Attitudes toward GM but were neutral in regards to their perceptions related to Future Trends of Attitudes toward GM. Noelle-Neumann (1974) indicated individuals do not want to risk social isolation. One way to avoid social isolation is finding a social group and aligning with their viewpoints (Glynn & Park, 1997). However, if an individual is not sharing their opinions with the group on a regular basis, especially in a social media environment, the individual will not receive feedback (positive or negative) and their feeling of belonging will fade – socially isolating themselves. Therefore, once in a safe, social environment, group members are willing and eager to share their attitudes, thoughts and opinions. The findings from this study imply the respondents have found a social group, often referred to as echo chamber (Scheufele et al., 2006), where they feel Willing to Express their Attitudes toward GM, feel socially accepted for those attitudes, and want to engage. However, it does not imply that they are expressing these attitudes or opinions in a way that is exposing themselves to criticism. In future studies Willingness to Expose Attitudes toward GM should be analyzed within a specific context. Perhaps individuals feel willing to expose their attitudes in a safe environment but not in one where they are opening themselves up to criticism.

In terms of the Diffusion characteristics, the respondents neither
agreed nor disagreed GM was complex, observable, something they could try, or compatible with their current beliefs. While strong public opinions regarding GM exist, the public has little actual knowledge of the science (Lusk et al., 2005), which may explain the neutral response to the Diffusion characteristics. However, respondents agreed GM had a greater Relative Advantage compared to current production practices. Given the regulatory and consumer acceptance challenges associated with GM (Maghoub, 2016), further exploration of perceived Relative Advantage may be warranted to assist in legislative decision-making.

As theorized, the Diffusion characteristics did have an impact on the Spiral of Silence Attributes. Three of the Diffusion characteristics had significant positive direct effects on perceived Future Trends of Attitudes toward GM and four of the five Diffusion characteristics had a significant positive direct effect on respondents’ Perceived Opinion of Others. In addition, 95.4% of the variance in the interaction between Perceived Future Trends of Attitudes toward GM and Perceived Opinions of Others was predicted by the model, including the Diffusion characteristics. Compatibility and Observability had the largest indirect effect on the interaction.

In opposition to what you would expect based on Spiral of Silence theory (Noelle-Neumann, 1974), both Perceived Future Trends and Perceived Opinions of Others had a significant negative direct effect on Attitude toward GM. In addition, all five Diffusion characteristics had significant indirect negative effects on Attitude toward GM. Of the five Diffusion characteristics, Compatibility had the largest significant negative effect. Also, in opposition to Spiral of Silence theory (Noelle-Neumann, 1974), none of the variables in the model had a significant direct effect (positive or negative) on respondents’ Willingness to Expose his/her Attitude toward GM. In total, the direct and indirect effects of all the variables only predicted .10% of the variance in a respondent’s Willingness to Expose his/her Attitude toward GM.

The finding implies there is little to be done as educators and communicators that can alter Willingness to Expose Attitudes toward GM. However, this may be due to the echo chambers mentioned previously (Scheufele et al., 2006) and should be examined further to determine if the model works when Willingness to Expose Attitudes toward GM is set in an oppositional environment. The study could also be replicated in a developing country, as opposed to the U.S., where food is not readily available and GM is viewed as a solution or it could be replicated using a different ANR technology as the dependent variable. Perhaps examining a new water conservation technology or food safety protocol would elucidate further understanding of how the public makes decisions about agricultural systems.

Above all else, the findings revealed just how complex and multi-dimensional public decision-making about ANR issues can be (Trowler, 2012) and that when thoroughly vetted theoretical explanations are tested, they will not always have the expected result. The need to be innovative, collaborative, and discovery-driven in our approaches to research (Irani & Doerfert, 2013) is highlighted by the results that both support and oppose the theoretical model explored, further adding to our understanding of public decision-making around ANR issues. As the agricultural education and communication discipline strives to translate scientific solutions to real global challenges in a rapidly changing world (Lindner, 2018), it is more important...
than ever to recognize the role perceptions, social norms, emotions, ethics, morals, and politics play in the personal decision-making process; especially as it relates to exposing attitudes in an ever-changing social media environment.

References


Effect of Certification on Adoption and Sustainability of Organic Agricultural Practices

Raphael Mwiti Gikunda  
Chuka University, Kenya

David E. Lawver  
Texas Tech University

Abstract
This study highlights the importance of certification on the adoption and sustainability of organic agriculture (OA). The research took place in four counties of Central Kenya: Nyeri, Muranga, Kirinyaga, and Kiambu. Data were gathered from 329 farmers selected through stratified random sampling. A valid and a reliable (sustainability, $\alpha = .96$; adoption, $\alpha = .84$) semi-structured questionnaire was used for data collection. MANOVA followed with discriminant analysis was used to establish the differences between certified and non-certified farmers. The adoption levels of pest and disease control, weed, soil, and water management practices were higher among the certified farmers compared to non-certified farmers. Certified farmers also reported higher scores in the three dimensions of sustainability: ecological, social, and economic sustainability. Certification accounted for 15% of the variance in the adoption and sustainability of OA, $\Lambda = .85$, $F (7, 313) = 7.87$, $p < .05$, $\eta^2 = .15$. Certification had a large effect on the adoption and sustainability of OA. This can be attributed to need to meet certification and market requirements, better access to extension information, and premium prices attracted by certified produce. Therefore, non-certified farmers should be encouraged to certify their production systems. Increased contacts between farmers and extension agents is also a basic necessity.

Keywords: adoption; certification; organic agriculture; diffusion of innovations; sustainability
Introduction

Organic agriculture (OA) is one of the fastest growing agricultural sectors in the world today. However, the success of OA relies significantly on local conditions and entails use of natural resources such as land, vegetation, animal manure, legumes, cover crops, compost, mulch, and minerals (Brzezina, Kopainsky, & Mathijs, 2016). This makes OA system compatible with the existing values and needs of the potential adopters (Rogers, 2003). According to the Organic Farming Research Foundation (OFRF) (2011), OA makes an important contribution to the economy and wellbeing of farmers. The demand for organic produce has expanded worldwide. The United States, which reported the highest annual sales in organic production of $97 billion in 2017 and $106 billion in 2018, is ranked at the top globally. Other large consumers of organic products include Germany ($11.3 billion), France ($8.9 billion), and China ($8.6 billion). Switzerland was the country with the highest per capita organic expenditure at about 6% of total food in dollars (Willer & Lernoud, 2017). OA certification is undertaken to ensure that organic regulations are being followed with verification, inspection, and record keeping (IFOAM, 2005).

Willer and Kilcher (2010) reported that by the 1970s organic food was becoming popular, resulting in the formulation of organic standards in Europe and the United States that could guide certification. Certification does not only open doors for new markets and valuable economic opportunities, but also helps improve product differentiation, ensures product value, and boosts consumer confidence. According to Reganold and Wachter (2015) farmers are increasingly converting to certified OA systems in order to capture high-value markets and premium prices for the produce, and thus boost farm income. The premium prices of organic produce raises the relative advantage of OA over conventional systems making organic production attractive for adoption (Rogers, 2003). Willer and Lernoud (2015) reported that as of 2015, there were 283 organizations in 170 countries. Internationally, many organizations are using IFOAM’s set of organic standards as a basis of formulating their local standards (IFOAM, 2005).

Despite the proliferation of certifiers in both developed and developing countries, there are many farmers who are applying organic practices but are not certified organic (Reganold & Wachter, 2015). Caceres (2005) confirmed that shifting from conventional to non-certified OA has proved to be a very successful strategy for subsistence farmers. The conversion to OA allows the subsistence farmers to grow, consume, and sell the surplus as well as to improve their food safety and conserve the environment. Certified farmers obtain better prices for their produce than non-certified as noted by Constance, Choi, and Lyke-Holgland (2008). OA practices are easier to adopt as they do not require a lot of technical knowledge. Most practices rely on tacit and traditional knowledge that is possessed by many farmers, thus making adoption much easier even to the uneducated (Rogers, 2003).

The dissemination of OA practices relies majorly on diffusion of innovation theory principles (Rogers, 2003) where most farmers decide to adopt the practices on the basis of social values and norms disseminated through interpersonal networks. This mainly involves change agents with connections both within and outside of local communities (Atwell, Schulte, & Westphal, 2009; Rogers, 2003). Certified farmers are more economically motivated through incentives such as advance payments, provision of inputs, and credit facilities (Constance, et al., 2008), and
this speed up the rates at which they adopt the practices (Rogers, 2003). Taylor (2006) asserts that certified OA has existed in Kenya for many years. Three bodies are involved in ensuring organic standards and thus certifying OA; EnCert, Nesvax, and Kenya Organic Agricultural Network (KOAN). KOAN is a national coordinating body for OA activities in Kenya. With global population increases being witnessed, the demand for organic products is going to double, if not triple, resulting in an increase of certification levels due to growing food security concerns. Few studies have been undertaken to connect a certification of OA to the adoption of the practices and subsequent sustainability of those practices. This study was therefore designed to address that paucity.

**Theoretical Framework**

This research is based on the assertions of Rogers’ diffusion of innovation theory (Rogers, 2003) to investigate the adoptive behavior of certified and non-certified farmers with regard to OA practices. As illustrated in Figure 2, Rogers (2003) proposed four main elements that determines the rate of adoption of innovations; innovation itself, communication channels, time, and a social system. According to Rogers (2003), an innovation must be widely adopted in order to be self-sustainable. As such, OA practices must be widely disseminated and adopted to self-sustain. The dissemination of these practices take place through varied sources and channels, although, much of the information flows through social networks. The nature of network and change agents determines the possibility of the new practices to be adopted (Atwell, et al., 2009).

Diffusion research had shown that capital and proximity to the source of innovation (Tarde, 1969; Goss, 1979), plays a substantial role in the adoption and distribution of innovations. Rogers (2003) cites the attributes of innovations; relative advantage, compatibility, complexity, trialability, and observability as the predictors of adoption rates. Among the characteristics, relative advantage has been found by diffusion researchers to be one major predictors of rate of adoption. According to Rogers (2003) relative advantage as the ratio of expected benefits and costs of adoption of an innovation. Farmers are likely to convert to OA if they are convinced of its benefits over and above those of conventional farming systems. OA has unique characteristics that make it advantageous to smallholder farmers in line with Rogers (2003) relative advantage, complexity, and compatibility attributes.

OA has been found to be suitable for many cadres of farmers as it involves predominantly low production costs (Brzezina, Kopainsky, & Mathijs, 2016). Organic farms have proven to be profitable even though there is a decrease in yields as farmers convert to OA (Nemes, 2009). The farming system involves the use of indigenous knowledge of the natural environment and of the unique relationships between biotic and abiotic components of the environment. These benefits coupled with its profitability makes it attractive for smallholder farmers especially those in developing countries (Rogers, 2003). However, the full benefits of OA cannot be achieved until the production process is certified. This study hypothesized that certification may be associated with higher adoption of OA practices and it’s sustained utilization.
Purpose & Objectives
This research sought to generate information that would deepen the understanding of the importance of certification of OA with regard to adoption and subsequent sustainability of OA practices. The specific objectives that guided the study were to:
1. Describe the levels of adoption and sustainability of organic practices in Central Kenya, and;
2. Examine the perceived effect of certification on adoption and sustainability of organic practices.

Statistical Hypothesis
The omnibus hypothesis tested was:

\[ H_0: \text{there are no significant differences in the adoption and sustainability of OA practices between certified and non-certified organic farmers} \]  
\[ (HO: \mu_1 = \mu_2) \]

Methodology
Study Population & Sample
The population for this study consisted of 26,954 certified and non-certified organic farmers from Nyeri, Kiambu, Kirinyaga, and Murang’a counties of Central Kenya. A descriptive survey was adopted to gather farmers’ perceptions (Fraenkel, Wallen, & Hyun, 2015) on the adoption and sustainability of OA so as to address the purpose of the study. The population of the study was organized in counties (strata), thus stratified random sampling was applied to select the study sample. The choice of the sampling method was not only meant to achieve population generalizability but also ecological generalizability in which results can be generalized in areas with similar conditions as those of the study area. The study was scheduled to cover a sample of 377 farmers (Krejcie & Morgan, 1970) however, only 329 farmers and farms were accessible due
Given financial and time constraints. This translated to 87.3% of the target sample.

**Data Collection**

Data were gathered by the use of a peer and expert reviewed semi-structured questionnaire. The questionnaires were administered with the assistance of enumerators who had been trained in order to empower them to collect reliable and valid data (Author, 2017). A pilot involving a random sample of 33 farmers was conducted in Nyandarua County. Pilot study data were used to analyze the internal consistencies of the study variables. The reliability analysis results indicated that the instrument was reliable as the Cronbach alpha values were above the acceptable alpha of .70 (Nunnally, 1978); sustainability $\alpha = .96$, and adoption $\alpha = .84$.

**Data Analysis**

The independent variables were the adoption and sustainability of OA practices. Application of organic practices, was assessed through the summated score of 27 Likert-type items involving four groups of practices. The groups included pest control, disease control, weed control, water, and soil conservation practices. The items evaluated the frequency of application of the practices and were scaled from 1 to 5, where 1 meant never and 5 implied always.

Sustainability of OA had three dimensions namely ecological, economic, and social sustainability. The variable elements were measured using a Likert-type scale of 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, and 5 = strongly agree and consisted of 16 items. The dependent variable was certification, a categorical variable measured in nominal scale (0 = non-certified, 1 = certified). Figure 2 illustrates the hypothesized linkages between the adoption and sustainability of OA, and certification of organic farms.

One-way Multiple Analysis of Variance (MANOVA) was used to establish whether there was a difference in the adoption and sustainability of OA among certified and uncertified organic farmers. MANOVA is used to test the differences between groups across several dependent variables simultaneously (Field, 2017). It is an appropriate statistical analysis when the purpose of the research is to assess if mean differences exist on more than one continuous dependent variable by one or more discrete independent variables (Dattalo, 2008). MANOVA uses the $F$ test to test the null hypothesis. If the obtained $F$-value is larger than the critical $F$, the null hypothesis is rejected (Dattalo, 2008). The null hypothesis was tested at .05 alpha level set *a priori*. 
Discriminant analysis was conducted as a follow-up analysis since the MANOVA $F$ test was significant ($p < .05$). MANOVA indicates whether groups means are significantly different, while discriminant function analysis indicates how groups differ; that is, which variables best differentiate the groups (Field, 2017). Prior to analysis, the assumptions of normality and homogeneity of variance/covariance matrices were assessed. The data were found to be normally distributed as reported by the values of skewness and kurtosis. Stevens (2009) posited that MANOVA is robust toward the violation of normality with respect to Type I error. Homogeneity of covariance matrices is the multivariate equivalent to the homogeneity of variance and was tested using Box's M test (Leech, Barrett, & Morgan, 2015).

The Box’s $M$ test, ($p < .05$) was significant implying that the assumption of homogeneity of covariance matrices was not met. Tabachnick and Fidell (2013) reported that in instances where group sizes are unequal and the bigger group produces a greater variance and covariance, then the probability values are conservative and significant findings can be trusted. The centroids for each group were computed and Wilk's lambda was used to test for significant differences between certified and non-certified groups. The standardized canonical discriminant coefficients were interpreted using the general rule that the coefficients whose absolute value is not less than one half of the largest value are considered in the discriminant function (Hair, Anderson, Tatham & Black, 1995). The hypothesis was tested at .05 level of significance set a priori.

Figure 2. A model linking certification of OA to adoption and sustainability of organic practices.
Results

The first objective sought to describe the levels of adoption and sustainability of organic practices in Central Kenya. The results are presented in Table 1 (adoption levels) and Table 2 (sustainability of organic practices).

Adoption of OA Practices in Central Kenya

As reported in Table 1, the study identified four groups of OA practices; weed, soil, water, pest, and disease management practices. Practices meant to manage pest and disease were the most frequently applied by both certified \((n = 222, M = 28.52, SD = 6.11)\) and non-certified \((n = 107, M = 23.91, SD = 6.83)\). This can be attributed to the prevailing environmental conditions that favor increased incidences of pest and diseases. Most of the pest and disease control cultural practices are simple to execute hence experience high adoption rates (Rogers, 2003). Water management techniques were the least applied by both certified \((M = 18.09, SD = 3.07)\) and non-certified \((M = 16.30, SD = 4.83)\). The poor adoption of water management techniques may have resulted from the lack of permanent sources of water and rainwater harvesting skills (Author, 2019). Very few farmers practiced irrigated farming \((certified, M = 2.35, SD = 1.29, non-certified, M = 2.17, SD = 1.30)\) and thus, agriculture in the region is heavily dependent on bimodal rainfall patterns characterized by two rainy seasons; long rains (March to July) and short rains (October to December) (Franzel, Wambugu, & Tuwei, 2003).

Among the certified farmers, composting which involves decomposition of plant wastes to make manure \((M = 4.42, SD = .78)\), use of organic matter \((M = 4.30, SD = .86)\), and mulching \((M = 4.16, SD = .98)\), to enrich, control weeds, and improve the water holding capacity of the soil, were the most frequently applied practices. Hand weeding to kill weeds \((M = 4.09, SD = 1.15)\), mulching \((M = 3.93, SD = 1.94)\), and application of organic matter \((M = 3.87, SD = 1.33)\), to enrich, control weeds, and improve the water holding capacity of the soil, were the most commonly applied practices by non-certified farmers. The adoption levels of these practices were higher compared to other practices as they were compatible with the setting, simple to use and involved use of indigenous knowledge (Rogers, 2003).

Based on the reported mean scores, the adoption levels of pest and diseases control \((M = 28.56, SD = 6.11)\), weed \((M = 23.54, SD = 4.92)\), soil \((M = 21.42, SD = 3.77)\), and water management practices \((M = 18.09, SD = 3.07)\) were higher among the certified farmers compared to non-certified farmers \((M = 23.91, SD = 6.83; M = 22.50, SD = 5.52; M = 19.50, SD = 4.47; M = 16.30, SD = 4.83\) respectively). The higher application of organic practices by certified farmers may have resulted from a higher number of contacts with private extension agents, regular inspections and audits, assurance of lucrative markets, and higher prices for their products (Muller, 2009). However, most of the practices had a mean score of 3 (Table 1) implying that farmers applied the practices occasionally rather than all the times. Most farmers cited lack of knowledge as the main reason why they were not utilizing the practices as frequently as they should be applied. As noted by Rogers (2003), knowledge is paramount to adoption of innovations. Non-certified farmers had less contact with private extension agents, thus they had little or no knowledge of some of the organic practices. These farmers must first learn about the organic practices before they can begin adopting them.
Table 1

Descriptive Statistics on Application of Organic Crop Production Practices (N = 329)

<table>
<thead>
<tr>
<th>Practices</th>
<th>Certified (n = 107)</th>
<th>Non-certified (n = 217)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Soils fertility management practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composting</td>
<td>4.42</td>
<td>.78</td>
</tr>
<tr>
<td>Mulching</td>
<td>3.92</td>
<td>1.02</td>
</tr>
<tr>
<td>Minimum tillage</td>
<td>3.57</td>
<td>1.01</td>
</tr>
<tr>
<td>Use of leguminous plants</td>
<td>3.32</td>
<td>1.21</td>
</tr>
<tr>
<td>Crop rotation</td>
<td>3.18</td>
<td>1.20</td>
</tr>
<tr>
<td>Use of Green manures</td>
<td>2.99</td>
<td>1.28</td>
</tr>
<tr>
<td>Weed Control practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand-weeding to remove weeds</td>
<td>4.12</td>
<td>.94</td>
</tr>
<tr>
<td>Mulching to stop weed seeds from germinating</td>
<td>3.65</td>
<td>1.19</td>
</tr>
<tr>
<td>Soil cultivation carried out at repeated intervals and appropriate time</td>
<td>3.70</td>
<td>1.05</td>
</tr>
<tr>
<td>Crop rotation to break the weed plant cycles</td>
<td>3.15</td>
<td>1.19</td>
</tr>
<tr>
<td>Green manures or cover crops to outcompete weeds</td>
<td>3.14</td>
<td>1.20</td>
</tr>
<tr>
<td>Planting crops close together within each bed, to prevent space for weeds to emerge</td>
<td>3.03</td>
<td>1.16</td>
</tr>
<tr>
<td>Use of mechanical weeders to kill weeds</td>
<td>2.72</td>
<td>1.43</td>
</tr>
<tr>
<td>Pest and disease control practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growing crops that suffer less damage from diseases</td>
<td>3.58</td>
<td>.87</td>
</tr>
<tr>
<td>Growing crops that suffer less damage from pests</td>
<td>3.54</td>
<td>.91</td>
</tr>
<tr>
<td>Crops with a natural resistance to specific pests</td>
<td>3.36</td>
<td>.99</td>
</tr>
<tr>
<td>Crops with a natural resistance to specific diseases</td>
<td>3.34</td>
<td>1.06</td>
</tr>
<tr>
<td>Timely planting of crops to avoid the period when a pest does the most damage</td>
<td>3.15</td>
<td>1.15</td>
</tr>
<tr>
<td>Providing natural habitats to encourage natural predators that control pests</td>
<td>3.06</td>
<td>1.43</td>
</tr>
<tr>
<td>Using crop rotations to help break pest cycles</td>
<td>3.03</td>
<td>1.26</td>
</tr>
<tr>
<td>Trapping or picking pests from the crop</td>
<td>2.98</td>
<td>1.32</td>
</tr>
<tr>
<td>Companion planting with other crops that pests will avoid, such as onion or garlic.</td>
<td>2.47</td>
<td>1.26</td>
</tr>
<tr>
<td>Water management practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic matter to the soil to improve its ability to hold water</td>
<td>4.30</td>
<td>.86</td>
</tr>
<tr>
<td>Mulches to hold water in the soil</td>
<td>4.16</td>
<td>.98</td>
</tr>
<tr>
<td>Rainwater basins or catchments</td>
<td>3.86</td>
<td>1.36</td>
</tr>
<tr>
<td>Use of terracing</td>
<td>3.35</td>
<td>1.36</td>
</tr>
<tr>
<td>Appropriate irrigation methods</td>
<td>2.35</td>
<td>1.29</td>
</tr>
</tbody>
</table>

Note: *1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always
Perceived Sustainability of OA Practices

Table 2 presents the farmers’ ecological, social, and economic sustainability of OA mean scores comparing certified and non-certified farmers. The majority of the farmers, both certified (n = 221, M = 23.37, SD = 3.19) and non-certified (n = 103, M = 22.19, SD = 3.85), indicated that use of organic practices enhanced economic sustainability the most as compared to social and ecological aspects. Overall, certified farmers indicated that the adoption of organic practices had ecological (M = 19.47), social (M = 20.80), and economic sustainability (M = 23.17) more than non-certified. This suggests that certified farmers are more likely to sustain their production than non-certified. Many of the certified farmers perceived that OA was sustainable as it resulted in increased yields in the long run (M = 4.33, SD = .79), improved health status of the members of the family (M = 4.30, SD = .76), food safety (M = 4.29, SD = .79), and reduced financial risks (M = 4.14, SD = .92).

According to non-certified farmers, safety of food was greater with OA (M = 4.40, SD = .92), yields gradually increased (M = 4.26, SD = .87), production costs were lower (M = 4.12, SD = .93), and the health status of the family members also improved (M = 4.11, SD = .92). Both certified and non-certified were in agreement that with time the yield increased to cover up the 19% gap that exists between OA and conventional systems (Schrama, Haan, de Kroonen, Verstegen, & Van der Putten, 2018). This, according to the farmers, was brought about by the gradual enrichment of the soil and improvement of its structure arising from continuous application of organic matter, composted manure, and other organic inputs.

Table 2

Comparison between Certified and Non-Certified Organic Farmers Based Upon Sustainability of OA (N = 324)

<table>
<thead>
<tr>
<th>Sustainability</th>
<th>Certified (n = 221)</th>
<th>Non-Certified (n = 103)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Ecological sustainability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintaining healthy soil free of chemical contamination</td>
<td>19.47</td>
<td>.16</td>
</tr>
<tr>
<td>Supports water conservation and water health</td>
<td>4.10</td>
<td>.77</td>
</tr>
<tr>
<td>Help conserve biodiversity as it encourages a natural balance within the ecosystem</td>
<td>4.00</td>
<td>.80</td>
</tr>
<tr>
<td>Increased usage of animal or green manure</td>
<td>3.91</td>
<td>.60</td>
</tr>
<tr>
<td>Reduces erosion through cover crops</td>
<td>3.65</td>
<td>.85</td>
</tr>
<tr>
<td>Social sustainability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved health status of family members</td>
<td>4.30</td>
<td>.76</td>
</tr>
<tr>
<td>Safety of food is greater with organic farming</td>
<td>4.29</td>
<td>.79</td>
</tr>
<tr>
<td>Provides access to attractive markets through certified products</td>
<td>4.00</td>
<td>.84</td>
</tr>
<tr>
<td>Improved quality of rural life</td>
<td>3.97</td>
<td>.97</td>
</tr>
<tr>
<td>Improves access to credit facilities</td>
<td>3.32</td>
<td>1.24</td>
</tr>
<tr>
<td>Economic sustainability</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23.37</td>
<td>3.19</td>
</tr>
</tbody>
</table>
Increasing yields in the long run & 4.33 & .79 & 4.26 & .87 \\
Reduces the financial risks involved in farming & 4.14 & .92 & 3.98 & 1.05 \\
Reduced costs of production & 4.05 & .89 & 4.12 & .93 \\
Allows farmers access to new market opportunities; local and international markets. & 3.88 & .77 & 3.64 & .92 \\
Job creation; labor use is higher on organic farms than on their equivalent conventional farms & 3.65 & .97 & 3.46 & 1.11 \\

Note: * 1= strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly agree

**Effect of Certification on Adoption and Sustainability of OA Practices**

Objective two sought to examine the perceived effect of certification on adoption and sustainability of organic practices. MANOVA was used to compare the means of certified and non-certified organic groups of farmers for the three dimensions of sustainability of OA namely: ecological, social, and economic and four aspects of application of OA practices (soil fertility, weed, water, pest and disease management practices). The independent variables were the application and sustainability of OA while the dependent variable was certification.

As reported in Table 3, a statistically significant MANOVA effect was obtained, Wilks' Lambda ($\Lambda$) = .85, $F (7, 313) = 7.87$, $p < .05$, multivariate $\eta^2 = .15$. The multivariate effect size was estimated at .15, a large effect (Cohen, 1992). This implies that 15% of the variance in the adoption and sustainability of OA was accounted for by certification. The findings suggest that certified organic farmers reported a greater application of soil, water, pest and disease control organic practices as a result of certifying their production. Petrokofsky and Jennings (2018) found a clear confirmation that certification contributes to the adoption of improved practices. OA certification demands adherence to certain practices and standards. To meet these standards, farmers have to apply pre-determined practices. Regular external and internal audits, coupled with continued provision of agricultural advice from the extension agents, all of which were geared towards ensuring that organic produce meets the certification standards, resulted in a sustained production. The differences witnessed in the adoption of practices is a clear confirmation that adoption does not happen simultaneously in a social system. Farmers adopted OA practices at different times, some reported a quicker uptake than others based on the degree of innovativeness of each individual farmer (Rogers, 2003).

Table 3

<table>
<thead>
<tr>
<th>Test</th>
<th>$V$</th>
<th>$F$</th>
<th>Hypothesis df</th>
<th>Error df</th>
<th>$p$</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillai's Trace</td>
<td>.15</td>
<td>7.87</td>
<td>7</td>
<td>313</td>
<td>&lt; .05</td>
<td>.15</td>
</tr>
<tr>
<td>Wilks' Lambda</td>
<td>.85</td>
<td>7.87</td>
<td>7</td>
<td>313</td>
<td>&lt; .05</td>
<td>.15</td>
</tr>
<tr>
<td>Hotelling's Trace</td>
<td>.18</td>
<td>7.87</td>
<td>7</td>
<td>313</td>
<td>&lt; .05</td>
<td>.15</td>
</tr>
<tr>
<td>Roy's Largest Root</td>
<td>.18</td>
<td>7.87</td>
<td>7</td>
<td>313</td>
<td>&lt; .05</td>
<td>.15</td>
</tr>
</tbody>
</table>

Note: *a,b 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always; b 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly agree
The MANOVA test was followed up with discriminant analysis (Field, 2017). Discriminant analysis was used to determine which weightings of the ecological, social, and economic sustainability, soil fertility, weed, water, pest and disease control organic management variables best discriminated between non-certified and certified OA groups of farmers. As shown in Table 4, discriminant function analysis revealed a significant Wilks’ lambda \( \lambda = .84, \chi^2 (7) = 51.17, p = < .05, R^2 = .15.\)

Table 4

<table>
<thead>
<tr>
<th>Variables</th>
<th>Structure Matrix</th>
<th>Standardized Canonical Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Function 1</td>
</tr>
<tr>
<td>Pest &amp; disease management</td>
<td>.82</td>
<td>.79</td>
</tr>
<tr>
<td>Water management</td>
<td>.54</td>
<td>.22</td>
</tr>
<tr>
<td>Soil management</td>
<td>.53</td>
<td>.39</td>
</tr>
<tr>
<td>Social</td>
<td>.41</td>
<td>.24</td>
</tr>
<tr>
<td>Economic</td>
<td>.39</td>
<td>.12</td>
</tr>
<tr>
<td>Weed management</td>
<td>.23</td>
<td>.58</td>
</tr>
<tr>
<td>Ecological</td>
<td>.14</td>
<td>.06</td>
</tr>
<tr>
<td>Wilks’ lambda</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function ( \lambda )</td>
<td>.85</td>
<td>( \chi^2 ) = 51.17, df = 7, p &lt; .05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eigenvalue = .18, % variance = 100, Canonical Correlation = .39</td>
</tr>
<tr>
<td>Group centroids</td>
<td></td>
<td>Certified = .29, Non-certified = -.60</td>
</tr>
</tbody>
</table>

Note: 62.6% of original grouped cases correctly classified.

This is the proportion (\( \lambda = .85 \)) of the total variance in the discriminant scores not explained by differences among groups. This also implied that the group (certified and non-certified) means differed significantly and the model was a good fit for the data. The eigenvalue was .18 (Table 4) indicating that the discriminant function explained 18% of the variance in group membership. Since there is only one function, 100% of the variance is accounted for by this function. The squared canonical correlation was .15 indicating that 15% of the variance in group membership was explained by adoption and sustainability variables. The standardized discriminant function coefficients presented in Table 4 indicate the relative importance of the independent variable in predicting the dependent variable. Hair, et al., (2005) assert that coefficients with large absolute values correspond to variables with greater discriminating ability. On the basis of the rule that those coefficients whose absolute value is not less than one-half of the largest value are considered in the discriminant function (\(.79/2 = .39\)). It was found that three out of the seven variables met the criteria and thus were considered in the discriminant function. Among the three categories of organic practices, pest and disease control measures had the highest discriminating ability (.79), followed by weed control (.58), and lastly soil fertility management practices (.39).
The structure coefficients signify correlations of each variable with each discriminant function and are interpreted the same way as factor loadings in factor analysis, by identifying the largest absolute correlations associated with the discriminant function. Hair, et al., (2005) recommends that coefficients greater than .3 be considered meaningful. Among the organic management practices several were found meaningful: pest and disease control (.82), water (.54), soil fertility (.53), social (.41), and economic sustainability (.39). The group centroids are the mean discriminant score for each variable in the two groups (Field, 2017). The centroid for non-certified was -.60 and .29 for the certified group. It also emerged from the findings that 69.1% of original grouped cases were correctly classified.

**Conclusions & Implications**

This study utilized four groups of OA practices; a) pest and disease control, b) weed control, c) soil fertility, and, d) water conservation practices. Most of the practices were being used on certain occasions although, pest and disease control practices were the most frequently applied by both certified and non-certified. An integrated approach involving biological, ecological, and physical measures were adopted to deal with pests and diseases. It also emerged that pest and disease management in OA is heavily reliant on precautionary measures rather than curative practices which are based on ecologically safer management techniques (Haldhar, Jat, Deshwal, Gora, & Singh, 2017).

The pest and disease management practices included growing healthy crops that are resistant and suffered less damage from pest and diseases, timely planting of crops to avoid the period when the pest causes most damage, companion planting with other crops that would repel pests, trapping or picking pests from the crop, rotating crops to help break pest and disease cycles and prevent carryover of pests to the next season, and providing natural habitats to encourage natural predators that control pests. Most non-certified farmers cited lack of knowledge as an impediment to the adoption of the practices (Rogers, 2003) and therefore, improved access to extension services could possibly help address the problem. Proper management of pests in OA is intensively cultural and therefore, requires keen monitoring and correct identification of insects and knowledge of their lifecycles (Stoleru & Sellitto, 2016).

Certification was associated with higher levels of adoption and perceived sustainability of OA. Certified organic farmers applied pest and disease, water, weed, and soil fertility management practices more than non-certified farmers as reported by the application scores. The high levels of application of OA practices among the certified farmers were as a result of the requirement and standards that go together with certification (Petrokofsky & Jennings, 2018) and frequent contacts with extension agents; in line with Rogers, (2003) assertion that ideas are first adopted by those closest to the sources. The contractual agreements signed between the certified farmers and the exporter companies purchasing organic produce from the farmers created an assurance of market and higher prices for their products (Muller, 2009) also contributed to increased application. This also corroborates Rogers (2003) claim that farmers are more likely to adopt innovations whose relative advantage is certain. The regular and continuous follow-ups conducted by the companies’ extension agents and farm inspections carried out on certified farms may also have propelled the high levels of application of OA practices witnessed.
As reported by Rogers (2003), diffusion of innovations occurs within a social context. Extension agents assigned to advise certified farmers’ not only provided OA information but also linked the farmers to other actors (research institutions, buyers, organic input dealers) in the organic industry. This created social networks that served as avenues of information and knowledge sharing. The application of organic water management practices was not as frequent as the other categories. The minimal application of irrigation techniques may have been brought by lack of permanent sources of water (e.g. rivers, wells, springs) and lack of knowledge of rainwater harvesting. This a confirmation of the findings of Author (2017), whose study recommended deliberate efforts to educate farmers on the resource needs of rainwater harvesting. However, many organic farmers practiced terracing and mulching to control soil erosion as well as to conserve soil water.

The findings also suggest that continued application of soil fertility, weed, water, and pest and disease management organic practices enhanced environmental, social, and economic sustainability. The finding that social sustainability was higher than economic and ecological dimensions explains the importance of social system in diffusion of innovations and their continued use (Rogers, 2003). The ecological sustainability entailed building and maintaining healthy soil that is free of chemical contamination, support water conservation, and water health, help conserve biodiversity as it encourages a natural balance within the ecosystem, reduction of soil erosion through cover crops, and increased usage of animal or green manure. Social sustainability entailed safety of food, improved yields, improved health status, access to attractive markets, improved quality of life, and improved access to credit facilities. Higher levels of economic, social, and ecological sustainability were associated with certified OA as reported by the sustainability scores. This implied that certified farmers were more likely to sustain their OA production more than non-certified. Therefore, non-certified farmers should be encouraged to certify their production process to boost adoption and sustain the practices.

References


management/pest-control-in-organic-systems


Beyond Diffusion of Improved Technologies to Promoting Innovation Creation and Information Sharing for Increased Agricultural Productivity: A Case Study of Malawi and Kenya

Fallys Masambuka-Kanchewa
Kevan Lamm
Alexa Lamm
University of Georgia

Abstract
For several decades, various sub-Saharan Africa governments have been proactive in revamping their agricultural extension service delivery systems through establishment and revisions of their agricultural extension policies. Despite the existence and implementation of these policies, productivity in small holder farms in these countries is still low several years later. The need to enhance agricultural production is still cited as a challenge, with low adoption of improved technologies being found as the major contributing factor. This study used a qualitative approach to examine farmers’ perceptions regarding the role of extension agents in the diffusion of innovations and its implications on sustainable agricultural development in Malawi and Kenya. Increased focus on using agricultural extension as an improved technology dissemination tool was found to be one of the factors contributing to low agricultural productivity. This among others was as result of failure by extension to tap valuable information, useful knowledge, skills and resources which was found to be available among farmers in both countries. The findings imply farmers no longer value their local knowledge and are uncomfortable sharing it amongst themselves. However, addressing the challenge of low agricultural productivity (heavily impacted by climate change) in these countries requires a shift in approach when delivering agricultural extension services. These changes include the use of interactive Information and Communication Technologies (ICTs) to solicit feedback and input from farmers and to enhance the two-way communication process.

Keywords: diffusion of innovations; extension education; improved technologies; policy
Introduction

Agriculture plays a critical role in the development of many countries in Sub-Saharan Africa, as it constitutes a very important sector for these countries’ economies (Dethier & Effenberger, 2012). However, for most developing countries, including Malawi and Kenya, agricultural productivity is very low - to the extent that most of these countries fail to feed themselves (Van Ittersum et al., 2016). The low agricultural productivity is primarily due to the limited adoption of advanced agricultural technologies (Dethier & Effenberger, 2012). In an attempt to improve productivity, several sub-Saharan African governments have been proactive in revamping their agricultural extension service delivery systems by establishing and revising agricultural extension policies (Abdu-Raheem & Worth, 2016).

Agricultural extension is known to play a very critical role in disseminating agricultural information in these countries. Therefore, it is believed that by supporting extension efforts the diffusion of improved technologies to farmers will occur, assisting farmers in improving the productivity of their farms (Gido, Sibiko, Ayuya, & Mwangi, 2015; Kibet, 2011).

The Malawi government started implementing a pluralistic demand-driven agricultural extension policy in the early 2000s. The objective was to ensure the availability of multiple players in service delivery to meet their farmers’ needs (Chowa, Garfoth & Cardey, 2013). The policy emphasized a need for decentralization of extension services provision as one way of improving effectiveness and efficiency (Masangano & Mnthinda, 2012).

The Kenyan government started implementing a decentralized extension delivery system in 2006 that was followed by structural reforms to enable the provision of extension services in order to improve accountability as well as meet farmers’ demands (Nambiro, Omiti & Mugunieri, 2006). Alongside implementation of the decentralized extension system, the Kenyan government also introduced a pluralistic demand-driven extension policy. It was aimed at ensuring that demand-driven extension services and participatory approaches were made available and started the process of commercializing extension service delivery (National Agricultural Sector Extension Policy, 2012).

Unfortunately, the low productivity of small farms is still cited as a challenge in these countries (as well as other developing countries) despite the existence and implementation of new extension policies due to the low adoption rates of improved technologies (Lunduka, Fisher & Snapp, 2012). A closer look at the role of extension in these countries reveals extension is still used for improved technology promotion and as a message dissemination tool with extension workers serving as technology promoters and farmers as passive recipients (Chowa et al., 2013; Gido et al., 2015; Masangano & Mnthinda 2012). The dissemination approach limits a feedback loop for incorporation of farmers’ knowledge and experiences which is crucial to the development and dissemination of improved technologies, resulting in technologies that do not address farmers’ needs (Atela, Tonui & Glover, 2018).

Unlike in the past, the presence of emerging issues such as climate change, has necessitated the need for a shift in extension service provision from being an information dissemination tool to a mechanism for promoting dialogue and innovation creation among and between farmers, policy makers and researchers (Kiptot & Franzel, 2015). Addressing the issue of limited productivity among the small farmers in developing countries calls for the need for collective
innovation and technology development that empowers farmers not only to demand technologies but to be engaged directly in technology development (Kirsten, Mapila, Okello & De, 2013).

**Theoretical Framework**

The study was guided by Rogers’ (2003) diffusion of innovation theory which examines peoples’ decision-making process regarding a new idea that is spread or accepted by people in a social system. Rogers (1976) defined an innovation as an object or idea that is perceived as new by a given society or group of people and diffusion as “the process by which an innovation, perceived as a new idea, spreads via certain communication channels over time among the members of a social system” (p.13). In this definition the role of communication channels in diffusing innovations is central. However, effectiveness of each communication channel varies depending on the stage at which the individual is in relation to the adoption process. Rogers (2004) identified five states an individual goes through in the decision-making process when decided to adopt or reject a technology; “knowledge, persuasion, decision, implementation, and confirmation” (p. 20).

Interpersonal communication channels have been known to be influential in enhancing diffusion and the adoption of scientifically proven technologies (Rogers, 1988). In this regard, extension agents have been known to play an important role in diffusing innovations, especially during the persuasive stage. Extension agents often refer to themselves as promoters of improved technologies (Anderson & Feder, 2004; Masangano, Kambewa, Bosscher & Fatch, 2017).

When extension agents identify themselves as promoters they unintentionally distance themselves from the scientists and researchers who reside outside the farmers’ social system (Dagron, 2009). Instead they are viewed as aligned with the farmer, given their personal contact, and viewed as the most effective way of communicating new innovations. Moreover, a positive correlation has been reported between the frequency that extension agents visit a farmer and the farmer’s ability to adopt improved technologies (Malawi Government, 2015; Nkonya, Schroeder & Norman, 1999).

Unfortunately, the emphasis on the role of extension agents as technology promoters limits the co-creation of new knowledge and inhibits farmers’ ability to work together to fully employ the diffusion of innovations (Moriba, Kandeh, & Edwards, 2011). In the past, the main challenges limiting the adoption of improved technologies was resistance to change, lack of resources and lack of opportunities to adopt new and improved technologies (Röling, Ascroft, & Chege, 1976). Now, the availability of information regarding improved technologies is no longer a challenge but rather the availability of quality technologies that address farmers’ needs (Elias, Nohmi, & Yasunobu, 2016).

**Purpose & Research Questions**

The purpose of this study was to examine farmers’ perceptions regarding the role of extension agents in the diffusion of innovations in Malawi and Kenya. The following questions guided the research:

1) How do farmers’ perceptions about the role of agricultural extension agents influence their innovativeness?
2) What are farmers opinions regarding the information provided by extension agents?
Methods

Using a constructivism approach, this study sought to examine farmers’ perceptions regarding the role of extension agents in the diffusion of innovations in Malawi and Kenya. This was done in an effort to empower marginalized individuals to share their stories and experiences, therefore, a holistic stance was employed (Creswell & Poth, 2016). Data was collected on site using qualitative methods which included direct observations and key informant interviews with farmers from Kenya and Malawi.

Data Collection in Malawi

With support from the headquarters for extension in Malawi, a list of all the districts in the country based on their ecological zones was obtained. From this list three districts were randomly sampled representing each ecological zone. Following this a list of Extension Planning Areas (EPAs) in each district was also obtained from which one EPA was selected. After selecting the EPAs, one village in each EPA was randomly selected. Convenience sampling was used to recruit participants, specifically, extension workers for each area communicated with a representative of the farmers about the researchers’ visit a day prior to the meetings. The village representatives then mobilized farmers who were available at that time the researcher was onsite to meet at a central place such as a church, community ground or school.

A semi-structured interview guide pilot tested with farmers from the state of Ohio in the United States was used for data collection through face-to-face interviews in Malawi. The interview guide included questions about farmers’ information sources, their experiences using various information sources, and their experiences using information obtained from the various sources. All the interviews were conducted in Chichewa, the vernacular language for Malawi and lasted for about one hour 30 minutes.

Data Collection in Kenya

The Seed Savers Network (SSN) was identified by the Kenya Forum for Agricultural Advisory Services (KeFAAS) as an ideal partner for this research in Kenya based on their engagement with multiple small holder farmers as well as farmer organizations. The SSN was identified as an organization that has emerged based on the rural advisory service, or extension, needs of clientele in the region. Semi-structured interviews with three representatives from the SSN were conducted while visiting their facilities located in the Rift Valley region of the country.

The semi-structured interview guide for the Kenya portion of the study was based on a larger set of research and evaluation objectives associated with the Framework for African Agricultural Productivity (FAAP) principles framed within the larger Comprehensive African Agriculture Development Programme (CAADP, 2015) issued by the African Union’s New Partnership for African Development (NEPAD). A subset of items specifically related to extension services and diffusion of innovations to farmers were analyzed as part of the present study. Additional questions were also included in the interviews and observations on site as part of a larger evaluation project.

Data Analysis

Participants were given a pseudonym as a way of covering their actual identities and protecting their privacy. The pseudonyms were based on the gender of the respondents with female participants being assigned full first names, such as Maria, and male participants assigned initials, such as KK.
The research design allowed for incorporation of emerging issues within an interview and between interviews (Morse, Barrett, Mayan, Olson, & Spiers, 2002). Therefore, data analysis was conducted during and after the data collection process. During the data collection process, the researchers made observations, took field notes after each interview, and analyzed the emerging themes which were then followed up in subsequent interviews. In addition, case-oriented analysis, which involves analyzing data case-by-case by comparing the researcher’s ideas with the data in order to develop an in-depth understanding of a given concept or context, was employed (Della Porta, 2008).

After transcribing the data, member checking was conducted. Finally, the primary researcher and another qualitative researcher who was not familiar with the study, analyzed the data using NVivo Pro, where themes and subthemes were generated and compared. When analyzing the data both inductive and deductive data analysis approaches were employed (Thomas, 2006). Inductive analysis involves the interpretation of the data by the researcher in order to generate themes and concepts while deductive analysis involved the interpretation of data by the researcher in order to compare if the data was consistent with assumptions or objectives that guided the research (Thomas, 2006). After analyzing the data, a third person who was familiar with the study reviewed the generated themes and sub-themes against the raw data as a form of peer debriefing (Lincoln & Guba, 1985).

Reflexivity Statement
As with all qualitative research, there is always an introduction of researcher bias. Therefore, it is important to share that, the primary and secondary researchers’ experience and knowledge may have influenced data analysis and interpretation. The primary researcher is a Malawian who had worked as a communication officer in the Department of Agricultural Extension for the Ministry of Agriculture in Malawi for several years. She was a doctoral student at a U.S. institution at the time of data collection and analysis. In addition, during this research, the primary researcher introduced herself as an extension agent to the farmers as it was easier for them to understand her role as compared to indicating that she was a communications officer. At the time data were collected and analyzed the other researchers were conducting an evaluation of the continental African Forum for Agricultural Advisory Services (AFAAS) network as part of a larger study. Furthermore, the other researchers had previous experience working with extension networks in over 50 countries from all six permanently inhabited continents.

Results
Farmers’ Perceptions About the Role of Agricultural Extension Agents
The participants were asked to describe their opinions regarding the role of agricultural extension agents. The main theme that was identified from their responses was that agricultural extension agents are there to provide information on improved technologies. In addition, as the farmers described the role of agricultural extension agents, the following sub-themes emerged: increased dependency on information provided by extension agents, poor regard for local and indigenous knowledge as well as resources, and failure of farmers to share local knowledge and innovations.

Increased dependency on information provided by extension agents. Through the interviews and observations, farmers indicated they rely too much on
information provided by the extension agents to the extent that they wait for the extension workers to tell them what to do. For example, Maria stated,

At one time they brought in this technology, we used to have mango tree that we were supposed to plant but we saw that the extension worker was not clear enough as to how we should plant the trees. So, it took a very long time before the extension worker came to tell us as to how we should plant the trees and by the time that they told us what to do most of the trees had dried and died.

In addition, when the participants were asked if they feel comfortable sharing their experience using various improved technologies in terms of the advantages and disadvantages, they indicated they depend on the extension agents to provide such information. For example, KK stated, “I cannot say much on that because you are the extension agent and you are the one who know the advantages and disadvantages because you advise us on what farming practices to follow.”

**Poor regard for local and indigenous knowledge as well as resources.** It was also observed that due to increased emphasis on the promotion of improved technologies, in some cases farmers consider the information delivered by extension agents as being superior. As a result, they are completely abandoning their local and traditional knowledge as summarized in the following response from Maria.

We completely left aside the traditional practices so that we follow the improved ones…We saw that the traditional and improved farming practices are different so we were not sure as to how we should go about it…We were like since they have brought new varieties so may be these require modern ways of planting due to effects of climate change since things have changed from the way they used to be in the past because of climate change.

In addition, other farmers also indicated they prefer getting information from technical experts as opposed to their fellow farmers as summarized in the following interview with TK.

“I prefer having access to information from a technical expert or government officials as opposed to another farmer because the farmer also learned from these officials or experts. Because even though the expert does not farm directly their messages are clear because the farmers can never be successful without the experts or officials…Therefore, we cannot take the farmer's sentiments seriously if they are not backed up by the officials or experts.”

**Inability of farmers to share local knowledge and innovations.** Additionally, in cases where farmers are still using or following traditional practices, they do not openly share such information unless they have established trust and feel safe as stated by TK.

I don't vaccinate them, ever since I started raising them, I do not vaccinate them. I have my own way. When the cow is sick, I get some leaves called “ndegere”…so when the cow is sick, I warm up some water with the leaves and I rub the leaves around the cow’s legs and my cows never die.

However, when this farmer was asked about their farming prior to this question,
they had indicated they follow improved practices and make sure they vaccinate their animals as indicated in the following response from KK.

I do, I raise cattle and vaccinate them often and they do not die. When some people say that there is an outbreak, my cattle are never affected…: The extension worker told me about it and said that I should be vaccinating my cattle and I follow that.

Moreover, the feeling of inferiority complex and fear of the consequences in cases where things might go wrong tend to make it hard for these farmers to share their knowledge with others even in cases where they are beneficial as stated by KK.

…If they approach me I would share with them…, but you can’t go to someone's yard and ask them to vaccinate their animals and use what I follow what happens when their cattle die? They will blame you for killing them or casting a spell on them so that is what am afraid of sure.

Despite increased focus on dissemination of information on improved varieties, observations from Malawi and Kenya have shown that farmers still value their traditional and indigenous species. For example, Kenyan farmers are responding positively to a project aimed at promoting diverse seed access to farming communities. In Kenya the SSN has emphasized that it is their mission to conserve agro-biodiversity by strengthening community seed systems for improved seed access and enhanced food sovereignty. According to representatives from the SSN there is significant interest from small holder farmers to learn how to clean and reuse seeds from season to season, thus reducing their dependence on seed salespeople. Additionally, there is interest in re-introducing indigenous vegetable varieties that had been previously removed from production in accordance with extension personnel recommendations. The indigenous varieties tend to be more climate adaptable and less reliant on inputs such as fertilizer.

Through the SSN in Gilgil, Nakuru County a variety of local crops are being grown which include maize, millets, fruits, carrots, kales, spinach and other vegetables. Through support from KeFAAS and some international funding organisations, SSN had initiated a project to catalogue local seed varieties. Moreover, the group conducts trainings for farmers and has also developed extension manuals and supporting documentation specifically directed at seed saving.

Farmers’ Opinions Regarding Information Delivered by Extension Agents

When the participants were asked about their opinions regarding the information that is delivered by extension agents; a number of themes emerged: inaccurate messages, one sided information and the inability of the information to address farmers’ needs.

Inaccurate messages. The participants indicated that in some cases the information the extension agents provided was inaccurate, which end up costing them resources and time. One example is summarized in the following response from WB:

I was told to grow maize using Kanyani seed and under conservation agriculture, I grew that crop and followed all the proper management practices and applied all the required inputs but when the crop was about to germinate the rains stopped and when the rains stopped all the maize
was damaged the whole acre. As such I had to remove the maize and ended up growing sweet potatoes however, I realized that all the fertilizer that I had applied and the seed that I had bought was just wasted all the money that I used to prepare the land was just wasted while some farmers who grew other varieties of seeds and I realized that all my friends were able to harvest something that year and yet I was not able to harvest and was hurt a lot because I am a small farmer and I struggle to get inputs and get fertilizer and that all the resources were wasted and I ended up growing sweet potatoes. All this happened because I accepted the advice that I should grow Kanyani variety and I did not benefit from it.

When asked about the impact of such experiences, the participants had the following to say:

Ever since that happened I never rush to grow these newly released varieties, right now I only plant a little bit of each variety so that if one fails I should be able to get something from the other one and right now I can’t tell you that I grow one variety if I say that then I will lie to you I stopped doing that.

However, despite facing such bad experiences, farmers do not provide feedback to the extension agents as indicated in the following statement from AB; “We did not tell the extension worker about our negative experiences. We only followed it for one year then abandoned it. So, the extension agent just brought another type of farming.”

**One-sided information.** The farmers’ expressed concern regarding the approach that was used when delivering messages on improved technologies. Among others, the farmers complained that in most cases such information only covers positive aspects of the technologies without providing any information about the setbacks as indicated in the following response Emma, “We are not able to get information on the negatives or challenges so that we are aware of the setbacks as well as the challenges that one can face from implementing a given technology or practice.” This was echoed by WB’s statement:

I should say that as a parent you are supposed to advise your child about the advantages and disadvantages of different options that if you follow this way you meet problems but follow this one. In the same way extension workers should be able to tell farmers that in this area when you grow this variety you do not benefit but grow this one that way the extension worker has provided guidance to us but if I just rush and grow the seed then I am the cause of the problem but if am advised and a told about the advantages and disadvantages then am able to know. Therefore, in that case it is important that the extension worker provides the information on the technologies that they promoting.

**Information provided is unable to address farmers’ needs.** The farmers were then asked to share their experiences in terms of the extent to which the information provided by the extension workers assisted them in addressing their needs. The farmers indicated that in some cases the extension agents did not provide them with any useful
information necessary as indicated in the statement from TK.

That time my garden had been infested with worms which were destroying the leaves in my garden and when I called the extension worker she came... And I said madam extension worker look at my garden, she went around and was like Mr. this is really bad alright, I will go and report to the office. I thought that at the office they will rush and address the problem because if they will not handle it with care it would end up being a disaster but we just saw that they were silent.

As a result of the frustration, farmers have resorted to implementing local and traditional practices as summarized in the following response Maria.

We just decided to follow the traditional methods because we saw that they were useful in areas where the improved methods were failing. So, we still use a portion of land and practice our traditional methods while another piece we practice the improved ones but we have seen that our traditional methods still work.

Conclusions, Implications & Recommendations
The findings indicated there was a focus on improved technology dissemination as the major role of the agricultural extension agents in both countries contributing to farmers’ inability to be innovative; promoting a dependency syndrome among the farmers. Farmers are not making use of their indigenous knowledge and skills and waiting to get advice from extension agents, even in situations where the farmers are aware extension agents are not knowledgeable.

Rich and valuable indigenous resources and knowledge that could have contributed to promoting agricultural development is left untapped as farmers fear sharing knowledge with their colleagues. There is a need for deliberate efforts aimed at integrating farmers’ indigenous knowledge and resources into the dissemination of new technologies as well as strengthening the peer-to-peer network among farmers in both countries (Šūmane et al., 2018).

Within the study frame the findings also imply the role of the extension agent should shift from being improved technology promoters to facilitators of dialogue around technology development and dissemination (Abdu-Raheem & Worth, 2016; Masangano et al., 2017). However, for that change to take place there is need for governments to revisit their priorities and shift their policies from focusing on the need to increase adoption of improved technologies to promoting knowledge and experience sharing among and between farmers, policy makers and scientists. This can be done by promoting initiatives like the one being implemented in Kenya where KeFAAS and SSN are working together with farmers to promote biodiversity as well as provide extension and advisory services to farmers.

On the other hand, there is also a need to promote investments in Information and Communication Technologies (ICTs) aimed at improving farmers’ participation and ability to provide feedback through the creation of interactive ICT platforms that enable farmers to share their local knowledge, experiences and skills (Hudson, Leclair, Pelletier & Sullivan, 2017). An increased investment in ICTs in most developing countries could provide the support needed for agricultural information dissemination (Ajani, 2014; Okediran, Ganiyu & Badmus, 2018). Currently, most ICT-oriented projects and initiatives give
little to no consideration to strengthening knowledge sharing among farmers as well as feedback provision through a two-way communication model.

Moreover, the results of the study indicated that in some cases extension agents seem to be lacking relevant competencies crucial to responding to farmers’ needs. This implies there is a need to improve professionalization among extension agents, so they are fully equipped to address the challenges that farmers in sub-Saharan Africa and worldwide are facing as a result of the negative impacts of grand challenges, such as climate change (Afful, 2016). The knowledge and skills required for extension agents to go beyond the provision of technical information to provision of moral support to farmers during times when they may be lacking technical expertise is a theme within the present study (Mangheni, Shimali, & Kabahenda, 2016; Umbara, Sulistyowati, Noor & Setiawan, 2019). For example, it may be more appropriate to act as a connector between local small holders and facilitator of conversation to share indigenous knowledge than it is to provide technical advice that may not be appropriate, or worse yet detrimental.

Furthermore, based on the study results there may be a need for the introduction and establishment of capacity building opportunities for extension providers that focus on social skills such as emotional intelligence in the various agricultural contexts. This skill set, when complimented by technical expertise, may be especially valuable during times of duress such as outbreaks and natural disasters. When natural disasters and outbreaks leave farmers financially and emotionally devastated, extension agents who are emotionally intelligent may be better able to provide support even in cases where they may not have the technical expertise.

Additionally, there is need for providers of agricultural extension services to take advantage of the available ICTs and use them to provide real time feedback and information to extension agents so they have adequate technical support whenever needed (Lamm, Lamm, Davis, Swaroop, & Edgar, In Press).

The results of the study are consistent with previous studies which indicated extension agents somehow dictate the technologies that farmers are supposed to adopt as opposed to providing them with technology options (Anderson & Feder, 2004; Masangano et al., 2017). This limits farmers’ ability to make independent decisions regarding which technologies to adopt or reject as well as take responsibility for their actions. Therefore, there is a need to ensure extension agents present farmers with technology options as opposed to dictating technologies. However, for this to be achieved, extension agents must not be evaluated based on the number of technologies they have promoted but rather on their ability to reach out to farmers, work with them to identify their needs, and develop solutions. This is the case because the current reporting system for extension agents in countries like Malawi requires the extension agents report the number of technologies they have promoted as well as number of farmers who have adopted the technologies. This perpetuates the desire among extension agents to dictate these technologies to farmers so they appear to be working.

The results of the study also indicated that contrary to what was purported in the Diffusion of Innovations theory (Rogers, 2003), where the people were supposed to be provided with information about the advantages and disadvantages of an innovation (Sahin, 2006), extension agents only tended to focus on positive attributes. This denies the
farmers access to information regarding the negative attributes of the innovations, hence their failure to prepare for setbacks as they make decisions to adopt a technology. In order to ensure farmers are fully prepared and capable of making informed choices on whether to adopt a technology or not there is need to make sure information on the negative attributes of the technologies is included as extension agents disseminate information on these technologies to farmers.

It is important to note the intent of this study was not to generalize findings beyond the experience and observations with small holder farmers and extension provisioners in two countries. However, the results of the present study provide intriguing contradictions to expectations associated with theory, therefore a recommendation is to replicate the present study in other countries using mixed methods. Although limited in scope, the findings provide valuable insights that are useful in providing direction especially when it comes to agricultural extension policy reforms. This is the case because in order to address the emerging issues such as climate smart agriculture that have greatly impacted countries in sub Saharan Africa and worldwide, there is need to make sure that agricultural extension policies include dissemination of indigenous and local innovations and knowledge and not only scientifically proposed technologies (Rivera, 2011).

The importance of policy reform, when it comes to addressing extension challenges, cannot be overemphasized. This is evidenced in countries like the United States where agricultural productivity is high and extension agents’ responsibilities goes beyond transfer of improved technologies to facilitators of dialogue between and among farmers and scientists so that research and technology generation incorporates farmers’ opinions, experiences and knowledge (Cash, 2001). Between, and even within, countries there is a tremendous amount of contextual variability. Adopting a one-size-fits-all approach may not be the most appropriate way to address the local realities faced by small holder farmers and supporting extension personnel. Finding the right balance between standardization and customization with the provision of extension services is a delicate balance; however, continued research in multiple contexts is necessary to ensure ongoing awareness and focus.

References


Atela, J., Tonui, C., & Glover, D. (2018). Farmers’ agency and experiences of


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